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Original Articles

Department of Dentistry for Children

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The International Journal of
Orthodontia and Dentistry
for Children

VOL. XIX ST. LOUIS, AUGUST, 1933 No. 8

ORIGINAL ARTICLES

FLEXIBILITY STUDIES ON GOLD ALLOY WIRES AND ORTHODONTIC APPLIANCES*

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I. PROPERTIES OF WIRES AND SIMPLE STRAIGHT SPRINGS

PRACTITIONERS of orthodontics are primarily concerned with prevention and correction of irregularities and malocclusion of the teeth which impair jaw function or facial form and balance. In accomplishing the correction of malocclusion, the profession is dependent to a great extent upon metallic springs and wire appliances which are constructed by the orthodontist to meet the needs of the individual case. It is important, therefore, that the orthodontist have a good understanding of the general mechanics of design and construction of these appliances, since few, if any, standard appliances are useful for this purpose.

It is recognized that numerous other problems concerning the growth of the individual under treatment and the physiology of his oral tissues present themselves in orthodontic practice. However, it seems obvious that the practitioner of orthodontia should be greatly assisted by the solution of the fundamental mechanical problems dealing with the appliances which it is necessary to use. It was with a view to the accomplishment of at least a portion of this purpose that this study was undertaken.

The actual displacement values for orthodontic springs are mainly dependent upon three conditions, namely, (1) wire diameter, (2) wire length, and (3) spring design. The pressures produced by the spring are also dependent largely upon these conditions; since the pressures delivered by ortho-

*From a portion of a dissertation submitted by F. A. Peyton to the Graduate School of the University of Michigan in partial fulfillment of the requirements for the degree of Doctor of Science.

dontic springs vary directly with the amount of their displacement. It is shown later that displacement is also dependent upon the modulus of elasticity of the material.

The primary object of this investigation has been to determine accurately the pressures exerted by displacement of the springs of representative types of orthodontic appliances, and to group together a number of the physical properties of the wires used to form the appliances. This twofold purpose appeared necessary, since there is no correlation reported in the literature between physical properties of wires and mechanical properties of appliances. Studies have been made on each separately, but a combination of the two does not appear. It did not seem improbable that a relation of the two might exist, but, as will be shown later, a relation is not outstandingly evident in this study.

The property of a spring appliance to exert pressure when displaced a given distance and then to return to its normal position when released, is often variously referred to as resilience, flexibility, or elasticity. Since these terms describe certain mechanical properties which possess definite and individual relations to the body or structure, they should not be confused in their usage.*

METHODS FOR MEASURING DISPLACEMENTS AND PRESSURES

From a survey of the literature it appears that only two investigators have reported methods to measure forces and displacements in orthodontic appliances. Each used a different type of instrument. The first in 1927 was called the Irishometer.[1] This instrument indicates both the pressure and the displacement. The Irishometer itself is not described in detail in the report, but from the photograph presented it appears to be built on the principle of the calibrated spring balance. The balance is supported rigidly, and provided with a graduated dial for indicating pressures, while the orthodontic appliance is moved over a graduated scale that measures displacement. Such an instrument has its limitations in measuring displacements when either equal or unequal loads are placed at several points simultaneously.

Korkhaus[2] has also described an instrument for measuring displacements of simple springs which indicates by means of a fixed, calibrated scale the pressure applied as the displacement changes, using a modification of the balance principle. Korkhaus has, however, used a somewhat less elaborate arrangement than that of Irish. With this instrument also, there is difficulty in making measurements with loads at more than one point simultaneously.

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*The flexibility of any structure may be defined as the ability of the structure to yield to pressure, provided the pressure is not sufficient to produce permanent deformation. The amount of flexibility in orthodontic springs is measured by the amount of displacement produced as a result of the application of a load within the elastic limit of the materials.

When a constant force is applied to a structure and the structure is deformed as a result of the force application, then work is said to have been done on the structure. Work is defined as the product of the constant force multiplied by the displacement. If the force is not constant, the work done is the product of the average force multiplied by the displacement, the average force being one-half the sum of the initial and final forces. It is the average force that is used in the calculation of the work done by orthodontic springs.

When this work has been done, then the properties of both resilience and elasticity become evident. The structure has, as a result of the application of the load, stored within itself elastic energy which may be used as mechanical energy when the load is removed. This elastic energy is called resilience. Resilience is, therefore, a measure of the quantity of energy in the form of mechanical work which may be obtained from a deformed structure. In an orthodontic structure it is this potential energy stored in the spring which is utilized in tooth movement.

The elasticity of a structure is that property by which the structure tends to return to its original size and shape after removal of the external load which produced the displacement. Elasticity describes the behavior of a body after it has been deformed.

These are the only methods that have been described, and both are somewhat limited in their application.

EFFECT OF WIRE DIAMETER, SPRING LENGTH, AND SPRING DESIGN

The only measurements reported in English for flexibility of different diameter wires have been given by Irish.[1] He has reported measurements on wires of four diameters, and has shown the effect of varying the spring length, although insufficient data are presented for any extensive correlation of the results. The measurements have apparently been taken on a number of practical case examples. McKeag,[3] in his discussion of physical laws governing the design of orthodontic appliances, has given a very general discussion of the effect of wire diameter as well as the effect of spring length in simple cantilever springs.

Nowack[4] has reported tests on several types of auxiliary springs, giving data to show the effects of applying loads at different positions on the springs. Korhaus[2] has likewise reported similar measurements. Both of these investigators have shown by their observations that springs of different design do not respond to the same degree of displacement when loaded similarly. Brief tables have been presented by each of these investigators to show that the forces of displacement for cantilever springs are less for wires of small diameter than for those of large, with observations that are in very good agreement with each other. Korkhaus has shown also that the flexibility of simple springs is practically unaffected by heat treatments.

Brumfield[5, 6] has shown that it is possible to calculate the flexibilities of springs of different design, which have been formed from different diameter wire. Numerous tables of flexibilities have been computed by Brumfield which show the desirability of certain spring designs from a structural standpoint. These data given by Brumfield serve to show that certain spring designs are more effective than others in accomplishing the purpose for which they are intended. The results of Brumfield's work will be considered again later when discussing the data on simple reflex springs.

Physical Properties.—In 1928 Coleman[7] reported an extensive investigation of the physical properties of wrought wires. His study directs special attention to such properties as chemical composition, tensile strength, and microstructure. By his study he has shown the effect of variation of manipulative procedures on the usefulness of materials in construction of mechanical dental appliances.

Taylor[8] and his coworkers described recently, in a preliminary report, their observations on the tensile strength and Vickers hardness values of wires that had been given different heat treatments. These results indicate also the effect of varying manipulative procedure. Taylor also shows the effect of varying specimen size in making the tensile tests.

Williams,[9] Brumfield,[10] and Paffenbarger, Sweeney and Isaacs[11] have also reported measurements on the physical properties of drawn wire, having made observations which support in a general way the results of Taylor and Coleman.

Present Investigation.—To obtain full benefit from a study of the properties of orthodontic springs a method of measurement should be employed by which any type of spring may be investigated simply and accurately over a large range of conditions. In much of the work reported on orthodontic appliances only the simplest types of springs have been investigated, and the application of force has been limited to one point only. This is obviously not the only condition encountered when the spring is in operation in the mouth. There are cases where the pressure is applied to only one tooth, but there are also many instances of a simple reflex spring moving as many as three or more teeth in one operation. It is, therefore, essential to use some method of measurement that will include all of these conditions. In this investigation springs have been studied under a variety of conditions, beginning with the simplest cantilever type. A simple and convenient apparatus has been employed for making the measurements, which will accommodate also the more complex forms of springs.

Method.—After some preliminary work the following apparatus and method were developed to determine the flexibility in orthodontic springs.

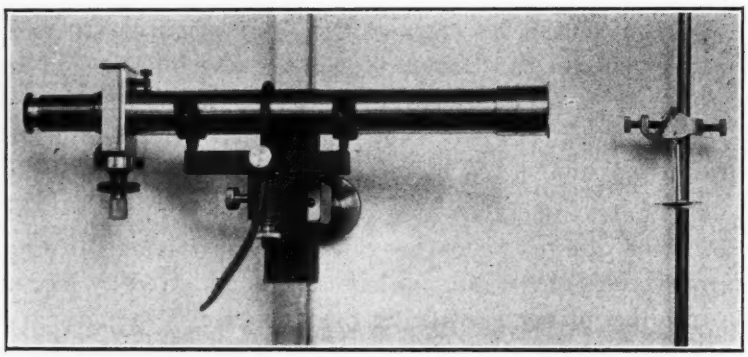


Fig. 1.—Cathetometer for measuring displacement.

The apparatus shown in Fig. 1 consisted of a short range telescope, or cathetometer, mounted on a graduated upright rod that was rigidly supported at the base. The telescope was provided with a cross hair, and could be raised or lowered until focused on the upper side of the spring which was being tested. A pivot mounting also allowed the telescope to be rotated horizontally for focusing on any point along the spring. The upright rod, graduated in millimeters, was equipped with a vernier that enabled accurate reading to 0.10 mm. (0.0039 in.).

The method of measuring consisted of placing the spring in a broach holder or pin vice that was clamped to a stand as shown in Fig. 2. Graduated gram weights were added to the spring at measured distances from the grip. These applied weights caused displacement of the spring, which was measured by adjusting the telescope again until the cross hair was focused on the upper side of the spring. The method may be applied equally as well to practical appliances as to appliances designed especially for study. For the purpose of establishing the displacement values produced per unit load, the simple skeleton spring was employed. Measurements were made on springs

soldered to an arch wire, to determine whether there was any change of value due to the soldering operation. If any effect was produced, it was so small that it could not be detected.

With this method of measuring, regular increments of either weight or displacement may be conveniently used as unity. Both methods have been used during this investigation, depending upon the convenience, and it will be pointed out which was used when analyzing the results. Curves were plotted showing the relation of amount of displacement to weight in grams. The results on a given wire of given spring design could readily be checked to ±0.10 mm. for displacement readings when using a definite load. At least three points on the curve were checked for each spring measured.

Materials.—In this study six different wires have been investigated. These wires have been chosen for this study as representing typical materials used for constructing orthodontic appliances. The composition of the wires is

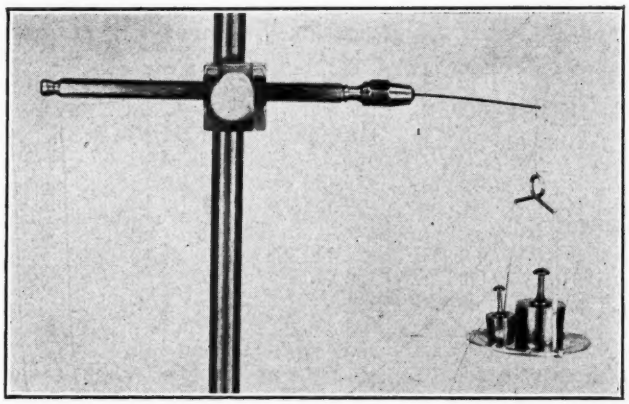


Fig. 2.—Simple cantilever spring displaced by load on free end.

given in Table I, and they will be referred to in the remainder of this report by the number under which they are listed in this table. In Table II are given a number of the physical properties of these wires. Tensile measurements were all made on 0.030 in. wire.* Heat treatments were made in the manner described by the American Dental Association Specification Number 7[11] for quenched and oven-cooled alloys. Measurements of tensile properties have not been taken on oven-cooled samples, since this treatment is not common in orthodontic practice. From studies of other investigators[7, 8] it is to be expected that these wires would show increase in both hardness and tensile strength when oven cooled.

The microcharacter hardness values were obtained by use of the instrument described by Bierbaum[12] for making such measurements; this method is quite convenient for small wires. The values are also quite comparable for indicating change of hardness in materials of the same nature.

*Many of the measurements reported had been completed before the American Dental Association Specification Number 7 had been published, which states that the wire diameter must be between 0.038 and 0.042 in.

The photomicrographs shown in Figs. 3 to 8 have all been taken from oven-cooled samples of wire. The wires were also examined micrographically

TABLE I

COMPOSITION OF GOLD ALLOY WIRES

(Percentage by Weight)

WIRE NO.	SILVER	GOLD	COPPER	PLATINUM	PALLADIUM	NICKEL	ZINC	IRIDIUM
1	6.8	58.6	13.6	16.5	4.4	–	0.03	–
2	14.9	59.2	9.8	15.9	–	–	–	–
3	–	74.9	8.6	–	–	16.4	–	–
4	8.4	58.9	12.7	17.3	2.6	–	–	0.06
5	14.4	54.9	10.0	14.3	5.1	0.13	1.1	0.13
6	13.6	62.8	12.6	10.0	–	–	0.8	–

TABLE II

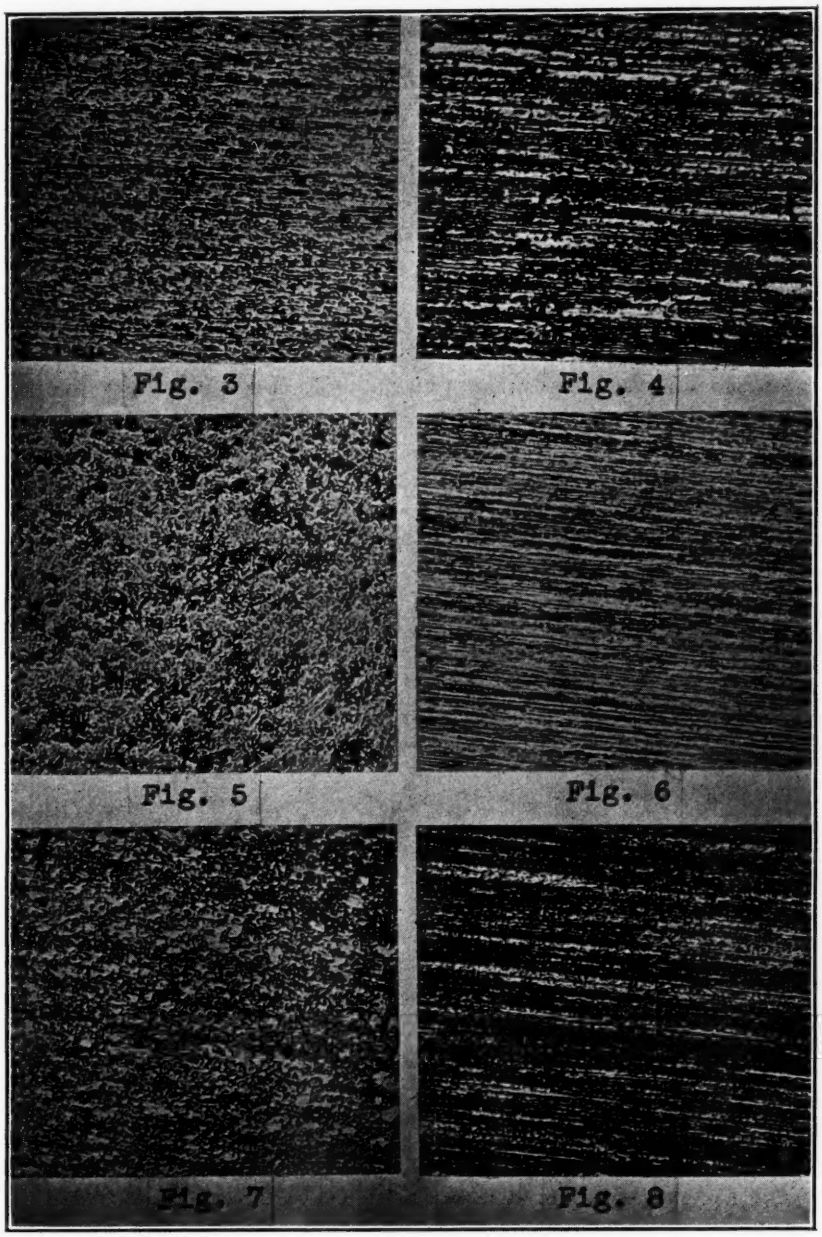
PHYSICAL PROPERTIES OF GOLD ALLOY WIRES

WIRE NO.	HEAT TREATMENT	PROPORTIONAL LIMIT LB./SQ. IN.	TENSILE STRENGTH LB./SQ. IN.	PER CENT ELONGATION	MODULUS OF ELASTICITY LB./SQ. IN.	MICRO-CHARACTER HARDNESS
						3 gr. wt.
	As Rec'd	100,000	128,000	11.2	15,000,000	260
1	Quenched	90,000	113,000	16.5	14,600,000	218
	Oven Cool					275
	As Rec'd	100,000	127,400	1.3	15,000,000	260
2	Quenched	75,000	95,000	13.3	15,000,000	185
	Oven Cool					275
	As Rec'd	90,000	122,600	12.5	16,000,000	260
3	Quenched	90,000	120,000	18.7	15,000,000	240
	Oven Cool					340
	As Rec'd	90,000	122,300	12.9	16,000,000	273
4	Quenched	90,000	109,000	14.2	16,000,000	200
	Oven Cool					340
	As Rec'd	95,000	124,500	7.0	15,500,000	273
5	Quenched	75,000	100,000	12.9	15,600,000	190
	Oven Cool					273
	As Rec'd	100,000	123,000	16.1	16,000,000	220
6	Quenched	85,000	102,000	11.3	15,500,000	180
	Oven Cool					273

both in the quenched condition and as received from the factory, and photomicrographs were taken. However, on examination of the photomicrographs no difference in structure could be detected due to the different heat treatments. Therefore only one series of photomicrographs has been given to show the typical structure of these wires. These microstructures were produced by etching with mixtures of fresh solutions of ammonium persulphate and potassium cyanide. A difference of structure is evident, however, in the six different wires studied. This is to be expected after observing the range of compositions presented by these wires.

Analysis of Results.—Simple cantilever springs. It was considered advisable to approach this study with one of the simplest spring designs used to correct irregularities of the teeth, and proceed to more complex designs; for that reason the simple cantilever spring was chosen. It seemed desirable to begin by testing completely this spring type under a number of conditions.

and then to apply the fundamental principles observed on this cantilever to the more complex designs and practical cases. This was done, however, with a full realization that other spring designs were perhaps more useful in many operations, although fundamentally they are more or less based on the properties displayed by the simple cantilever.



Figs. 3-8.—Photomicrographs showing typical structure of six wires studied. Oven cooled. Magnification ×250.

Fig. 3, Wire No. 1; Fig. 4, Wire No. 2; Fig. 5, Wire No. 3; Fig. 6, Wire No. 4; Fig. 7, Wire No. 5; Fig. 8, Wire No. 6.

In selecting the dimensions of the springs to be used for this study, it has seemed advisable to cover the same range as that covered by some of the most useful springs in actual practice. From clinical observations it was finally

decided to use lengths of 10, 20, and 30 mm. for the simple springs, to correspond with practical working limits. Four wire diameters were chosen, 0.018, 0.020, 0.022, and 0.030 in., as representing a useful range of diameters. Approximate results on intermediate diameters or diameters beyond these limits may readily be evaluated by deductions from the observed values.

Not only did it seem desirable actually to measure the forces and displacements of these springs, but it was also believed desirable to go somewhat into an analysis of the spring design. This not only tended to establish somewhat of a relation between these and other physical properties of the wires, but also served as a check on the observations and measurements. The relation of mechanical analyses and calculations to actual measurements and observations has, therefore, been carried out as far as possible within the limits of usefulness and undue complexity.

Although the formula for the deflection of the simple cantilever beam may be found in any standard text on *Strength of Materials,*[13] it seemed desirable to reproduce the final form of this formula for discussion in connection with its application to orthodontic springs. The formula is generally given as

$$y = \frac{Pl^3}{3EI} \qquad (I)$$

where

y = Displacement in inches
P = Load in pounds
l = Length of beam (or spring)
E = Modulus of elasticity—determined from tensile tests of wire—given in Table II of this report for each wire studied
I = Moment of inertia—which is calculated for a round wire from the formula

$$I = \frac{\pi d^4}{64}$$

where d = diameter of the wire and $\pi = 3.1416$.

It is readily seen that, given a wire of known diameter (d), length (l), and modulus of elasticity (E), it is very simple to estimate quite closely the displacement (y) produced by a given load (P). The above formula is the one most generally given in texts, but it may as well be written

$$P = \frac{3EIy}{l^3}. \qquad (II)$$

By substituting the known values for E, I, y, and l, into this equation, the pressure applied to the tooth may be calculated. These calculations have been made for most of the simple springs in common use, and the calculated values are given in Table III. Comparison shows good agreement with observed values.

It is also interesting to observe that by converting the formula to

$$E = \frac{Pl^3}{3yI} \qquad (III)$$

we have a means to determine the modulus of elasticity of the wire from the observed values for pressure and displacement of these simple springs, instead of from tensile tests. This E, modulus of elasticity, is the same as that obtained from tensile tests where it is equal to the unit load divided by the unit elongation of the test bar. This serves as a fairly accurate means of checking values for E in the wires used for orthodontic purposes, when the load and

TABLE III

EFFECT OF SPRING LENGTH AND WIRE DIAMETER

(Wire No. 3)

WIRE DIAMETER	LENGTH = 30 MM.			LENGTH = 20 MM.			LENGTH = 10 MM.		
	MM. DISPLACEMENT	WT. IN GR. OBS.	WT. IN GR. CALC.	MM. DISPLACEMENT	WT. IN GR. OBS.	WT. IN GR. CALC.	MM. DISPLACEMENT	WT. IN GR. OBS.	WT. IN GR. CALC.
0.018	0.0	0.00	0.00	0.0	0.00	0.00	0.0	0.00	0.0
inch	–	–	1.27	0.5	4.30	4.31	0.25	16.3	17.3
	1.0	2.49	2.55	1.0	8.40	8.63	0.50	33.3	34.6
	1.5	3.75	3.82	1.5	12.85	12.94	0.75	52.3	51.9
	2.0	5.08	5.10	2.0	17.60	17.26	1.00	66.3	69.2
	2.5	6.53	6.37	2.5	21.70	21.57	1.25	81.3	86.6
	3.0	8.00	7.65	3.0	26.50	25.89			
	3.5	9.30	8.92	3.5	31.00	30.20			
	4.0	10.75	10.20	4.0	34.90	34.52			
0.020	0.0	0.0	0.00	0.0	0.0	0.00	0.0	0.0	0.0
inch	0.5	1.8	1.96	0.5	6.4	6.62	0.2	17.0	21.4
	1.0	3.9	3.93	1.0	13.1	13.24	0.4	34.8	42.8
	1.5	5.7	5.98	1.5	19.2	19.86	0.6	53.8	64.2
	2.0	7.7	7.86	2.0	26.1	26.48	0.8	68.3	85.6
	2.5	9.8	9.82	2.5	31.7	33.10	1.0	89.0	106.2
	3.0	11.9	11.79	3.0	39.0	39.72			
	3.5	13.9	13.75	3.5	45.1	46.34			
	4.0	16.2	15.72	4.0	51.3	52.96			
0.022	0.0	0.0	0.00	0.0	0.0	0.00	0.0	0.0	
inch	0.5	3.1	2.88	0.5	10.1	9.67	0.2	29.9	
	1.0	5.6	5.77	1.0	18.3	19.35	0.4	52.4	
	1.5	8.9	8.65	1.5	27.4	29.02	0.6	79.4	
	2.0	11.4	11.54	2.0	35.2	38.70	0.8	100.4	
	2.5	14.4	14.42	2.5	44.3	48.57	1.0	122.4	
	3.0	16.9	17.31	3.0	52.9	58.05	1.2	148.0	
	3.5	20.0	20.19	3.5	62.3	67.72			
	4.0	22.7	23.08	4.0	–	77.40			
0.026	0.0		0.0			0.0			
inch	0.5		5.5			18.9			
	1.0		11.1			37.9			
	1.5		16.6			56.8			
	2.0		22.2			75.8			
	2.5		27.7			94.7			
	3.0		33.3			113.7			
	3.5		38.8			–			
	4.0		44.4			–			
0.030	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	
inch	0.5	9.7	9.83	0.5	30.4	33.15	0.2	88.4	
	1.0	19.6	19.65	1.0	58.4	66.20	0.4	155.4	
	1.5	27.7	29.50	1.5	91.4	99.35	0.6	220.4	
	2.0	38.6	39.30	2.0	119.4	132.40			
	2.5	47.9	49.30	2.5	153.4	165.55			
	3.0	57.9	58.80	3.0	178.4	198.60			
	3.5	67.9	68.80	3.5	210.4	–			
	4.0	77.9	78.65	–	–	–			

displacement have been determined accurately. In this study, where wire No. 3 was most frequently used in collecting data on simple springs, the value of E for this wire is given in Table II as 16,000,000 lb./sq. in. when determined from tensile data, and by the above formula it is calculated to be 15,500,000

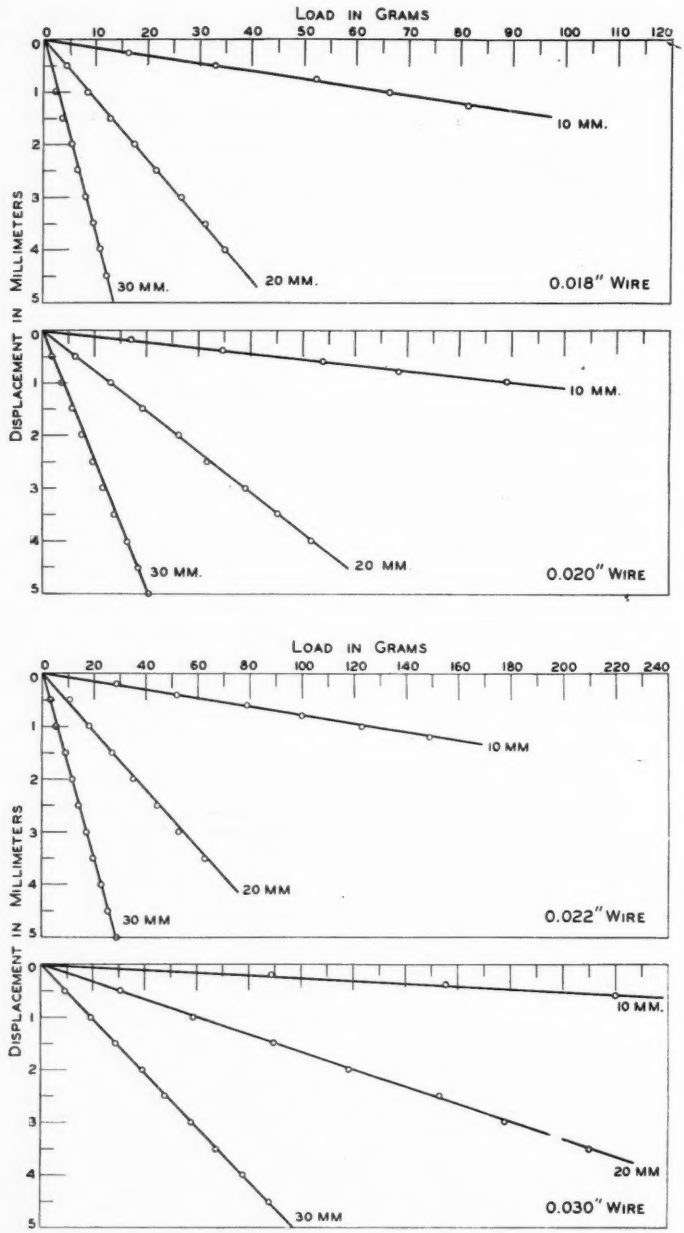


Fig. 9.—Effect of spring length and wire diameter on simple cantilever springs. Wire No. 3.

lb./sq. in. These two values are in sufficient agreement to demonstrate that corresponding values for E may be obtained by either method. It is now apparent how flexibility of the structure may be directly related to modulus of elasticity of the material.

Table III includes all of the data taken on simple cantilever springs with concentrated loads. These data have been plotted in Figs. 9 and 10. It should be explained that curves based on these data have not been made in the conventional manner of coordinate graphing. Rather, these curves present a reverse form, or image. This method of plotting was adopted with the thought that values might be somewhat easier to visualize, since the graph in each case represents an exact picture of the cantilever balance beam, with its origin at the left, load applied at the right, and displacement normally downward. It should also be pointed out that all of the observed values in Table III were

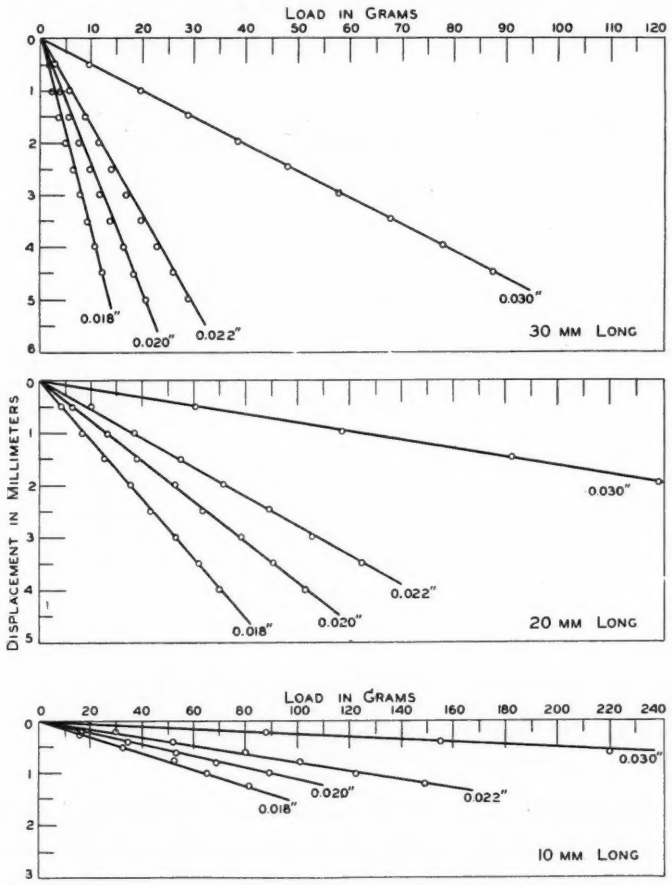


Fig. 10.—Effect of spring length and wire diameter on simple cantilever springs, showing clearly the effect of spring length.

obtained from wire No. 3, in the original condition as received from the factory. Heat treatment effects on these wires are shown in later tables and graphs.

In all measurements on simple cantilever springs with concentrated load the measurements of displacement were taken as unity, with sufficient weight added to displace the spring a unit distance. Only in the case of measurements on some of the reflex cantilever springs with uniform load, was the applied load taken as unity, and the amount of displacement resulting from unit load application noted.

The purpose of Fig. 9 is to show the uniform manner in which data for different spring lengths present themselves in the case of each of the four wire diameters tested. This illustration shows clearly that there is a distinct difference in the amount of displacement produced by the unit load on each spring length, regardless of wire diameter. This is more clearly shown in Fig. 9 than in Fig. 10, where the purpose was to plot the same data in a different grouping so that emphasis is placed on the relation of the four diameters of wire to each other, in each of the different spring lengths. In other words, it is more clearly brought out in Fig. 10 that there is a "family" relationship among the wire diameters for each spring length tested. It is also shown clearly by Fig. 10 that as the wire diameter increases, there is a regularity in the load increase for unit displacement, in each spring length. Com-

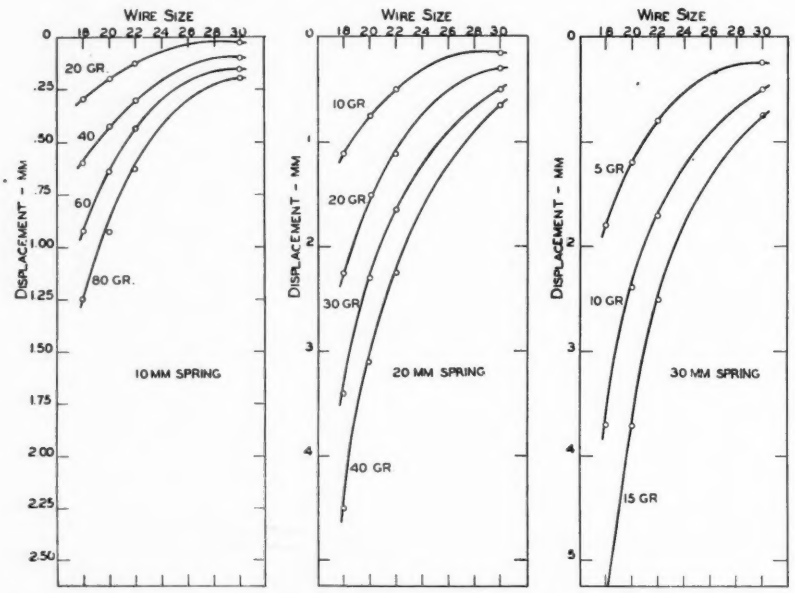


Fig. 11.—Relation of displacement to wire diameter (thousandths of an inch) for different loads on different length straight springs.

parison of overlapping values of displacement and load for wire diameters of different length springs may readily be evaluated from these curves.

The calculated values given in Table III have not been plotted, but it will be seen that there is very little disagreement between calculated and observed readings. When plotted, the calculated values fall on the curves given for observed values. The values obtained by substitution in Equation I and the observed values do not check so well for shorter springs of large diameter wire. These, however, are considered to be beyond practical working limits, in addition to the fact that the probability of error in reading is somewhat greater with those springs which demand heavy weights; so although the difference in actual values appears large, the percentage difference may be of the same order as between lighter springs.

The calculated values for the 0.026 in. wire have no observed values with which to check, but it is interesting to observe how these values fit on the

curves shown in Figs. 11 and 12. These curves represent only a selected number of readings taken from Table III, or from curves in Figs. 9 and 10. The curves in Fig. 11 are designed to show approximately the displacement of springs of each diameter wire between limits of 0.018 and 0.030 in., when displaced by unit load. This gives a means to estimate the displacement values of intermediate wire diameters not measured in this study, when using unit load on springs of known length. The calculated values for 0.026 in. wire arrange themselves nicely on these displacement curves.

The curves in Fig. 12 are of the same general nature as those of Fig. 11, except that in this case is shown the load in grams necessary to produce unit displacement of the spring for each diameter wire. The pressures produced when a spring of known diameter and length is displaced a unit distance, may be conveniently estimated from these curves. Here again the calculated values

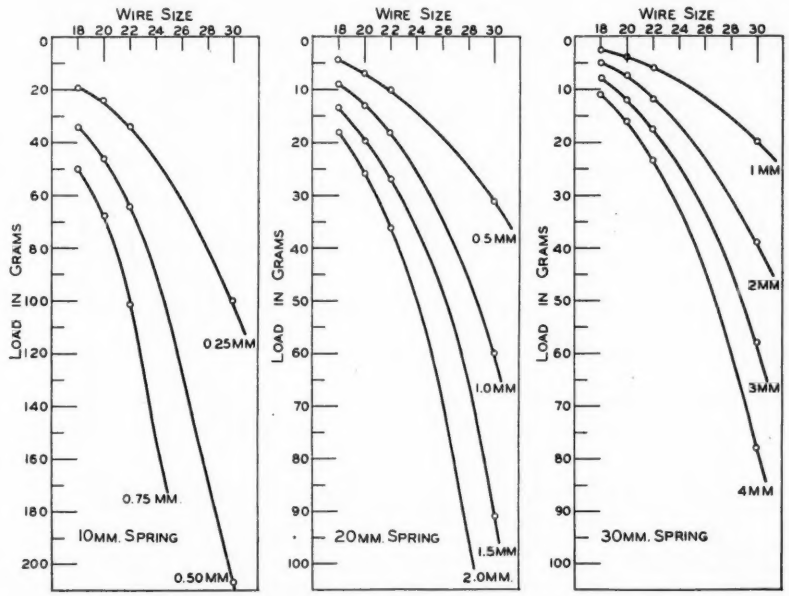


Fig. 12.—Relation of load to wire diameter (thousandths of an inch) for definite displacements on different length straight springs.

for the 0.026 in. wire in Table III arrange themselves nicely on the curves in Fig. 12 and serve as an indirect check on these values.

It is interesting to observe that the values plotted in Figs. 11 and 12 may be plotted as straight lines when semi-logarithmic paper is used. This indicates that from these curves it is possible to derive a simple equation whereby the values for any point on the curve may be determined. The values of the equations for these curves depend upon the slope of the line. However, it was considered to be out of the range of this study to go into the mathematical and mechanical treatment of this phase of the work, since it would have very limited application to orthodontic springs in general. Furthermore, the most suitable general formula to determine displacement values of cantilever springs has already been given in Equation I.

Values are given in Table IV for the displacement readings of cantilever springs of all six wires investigated. The springs were all formed of 0.022

TABLE IV

LOAD DISPLACEMENT RELATIONS FOR SIMPLE STRAIGHT SPRINGS OF SIX DIFFERENT WIRES. NO HEAT TREATMENT

(0.022 in. Diameter)

DIMENSIONS SPRING LENGTH	MM. DISPLACEMENT	LOAD IN GRAMS ON WIRE NUMBER 1	2	3	4	5	6
30 mm.	0	0	0	0	0	0	0
	0.5	2.7	2.6	3.1	3.2	2.4	3.2
	1.0	6.0	5.2	5.6	7.0	5.1	6.2
	1.5	9.1	7.7	8.9	9.2	7.1	9.1
	2.0	12.3	10.4	11.4	12.5	9.6	12.1
	2.5	14.8	12.9	14.4	15.4	12.1	14.9
	3.0	17.9	15.8	16.9	18.6	14.4	18.0
	3.5	20.9	18.0	20.0	21.4	16.8	21.0
	4.0	24.3	20.9	22.7	24.8	19.3	23.7
20 mm.	0	0	0	0	0	0	0
	0.5	9.0	8.3	10.1	10.4	6.5	9.1
	1.0	18.3	16.8	18.3	19.6	15.3	18.0
	1.5	27.8	24.8	27.4	28.4	22.8	27.8
	2.0	38.3	33.6	35.2	39.3	30.6	36.9
	2.5	47.8	41.4	44.3	47.9	37.5	46.3
	3.0	58.8	50.3	52.9	58.6	45.8	58.3
	3.5	–	59.3	62.3	68.3	53.3	65.3
10 mm.	0	0	0	0	0	0	0
	0.2	28.3	26.3	29.9	33.3	27.8	20.3
	0.4	52.3	47.3	52.4	52.3	59.3	39.3
	0.6	75.3	73.0	79.0	85.3	80.0	61.0
	0.8	101.3	–	100.0	103.0	101.0	90.0
	1.0	128.3	121.0	122.5	129.0	118.0	119.0

TABLE V

LOAD DISPLACEMENT RELATIONS IN SIMPLE STRAIGHT SPRINGS OF SIX DIFFERENT WIRES. QUENCHED FROM 700° C.

(0.022 in. Diameter)

DIMENSIONS SPRING LENGTH	MM. DISPLACEMENT	LOAD IN GRAMS ON WIRE NUMBER 1	2	3	4	5	6
30 mm.	0	0	0	0	0	0	0
	0.5	3.1	2.5	2.5	3.0	2.6	2.8
	1.0	6.1	5.4	5.1	6.0	5.3	5.8
	1.5	9.0	8.0	7.6	8.8	7.8	8.7
	2.0	11.9	10.8	10.5	12.2	10.2	11.7
	2.5	14.0	13.3	13.1	14.9	12.6	14.7
	3.0	17.9	16.0	15.6	18.0	14.6	17.8
	3.5	20.8	18.7	18.1	20.9	17.5	20.6
	4.0	–	21.7	20.9	–	19.6	23.5
20 mm.	0	0	0	0	0	0	0
	0.5	8.6	9.3	9.5	9.5	9.0	9.2
	1.0	17.5	17.6	18.4	19.0	16.5	19.3
	1.5	26.7	26.3	26.3	28.8	24.6	28.5
	2.0	35.5	34.8	38.3	38.3	33.1	37.3
	2.5	44.6	42.8	44.5	47.8	40.8	47.5
	3.0	52.9	50.8	52.8	58.3	48.3	56.3
	3.5	61.3	57.3	61.3	66.8	56.3	64.3
10 mm.	0	0	0	0	0	0	0
	0.2	27.3	30.0	28.0	31.0	27.3	24.0
	0.4	51.3	51.0	53.0	61.0	46.3	44.0
	0.6	78.0	71.0	74.0	90.0	69.0	70.0
	0.8	101.0	93.0	–	113.0	88.0	93.0
	1.0	123.0	110.0	116.0	133.0	101.0	115.0

in. wire and the springs were measured in the usual three lengths. Data in Table IV represent values obtained on wires as received from the factory without further heat treatment. No calculations were made to check observed values, but it will be seen that the values agree closely among themselves relative to the magnitude of load necessary to produce unit displacement in each spring length. Values given in Table IV are plotted in Fig. 13 (as received).

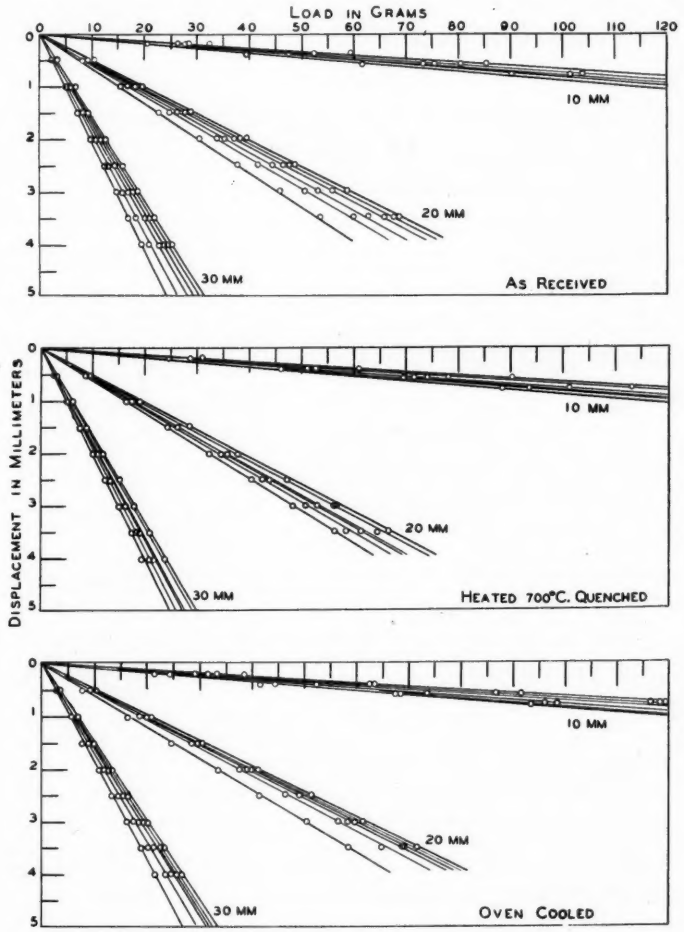


Fig. 13.—Load displacement relations for simple cantilever springs of six different wires and given three different heat treatments.

Data in Table V, representing the values for all six wires quenched from 700° C., are plotted in Fig. 13 (quenched). These values are likewise closely related and show very little difference in flexibility of the different wires tested. It is interesting to note that these values are also not noticeably different from the values on the wires as received from the factory. This observation may be carried still further to Fig. 13 (oven cooled), which represents the data of Table VI taken on wires given the hardening treatment by oven cooling. Values for all three sets of data are of the same order and similarly grouped according to spring lengths and wires tested.

The maximum percentage difference between the values of the six wires tested under similar conditions is slightly greater between those as received from the factory than between those given heat treatment. This difference is small when measured in terms of *actual* weights, and it is only after more work has been done on tissue changes which result from slight changes in pressure that the significance of these percentage differences between the several wires can be fully evaluated. Since it is difficult to obtain scientifically accurate controls, valuable research on tissue changes such as that suggested above is at present, and may continue to be for some time, impracticable.

TABLE VI

LOAD DISPLACEMENT RELATIONS IN SIMPLE STRAIGHT SPRINGS OF SIX DIFFERENT WIRES. OVEN COOLED

(0.022 in. Diameter)

DIMENSIONS		LOAD IN GRAMS ON WIRE NUMBER					
SPRING LENGTH	MM. DISPLACEMENT	1	2	3	4	5	6
30 mm.	0	0	0	0	0	0	0
	0.5	3.4	3.0	3.2	3.2	2.6	3.0
	1.0	7.0	6.0	6.5	6.6	5.7	6.3
	1.5	10.0	8.8	9.3	10.1	7.9	9.5
	2.0	13.1	11.9	12.4	13.4	11.1	12.5
	2.5	16.4	14.6	15.3	16.6	13.5	15.5
	3.0	19.5	17.5	18.3	20.0	16.1	18.8
	3.5	22.7	20.3	21.5	23.3	18.9	21.8
	4.0	25.9	23.5	24.3	26.6	21.6	24.9
20 mm.	0	0	0	0	0	0	0
	0.5	10.3	9.0	9.9	10.0	7.7	9.5
	1.0	21.0	18.8	20.3	19.8	15.5	19.4
	1.5	31.1	28.5	30.5	30.4	24.5	29.8
	2.0	41.2	37.3	39.0	39.3	33.3	39.5
	2.5	51.3	46.3	49.0	49.3	41.3	49.5
	3.0	61.3	56.3	58.3	59.8	50.3	59.3
	3.5	71.5	64.0	69.3	–	58.8	68.8
10 mm.	0	0	0	0	0	0	0
	0.2	38.3	21.0	24.0	33.0	29.8	31.8
	0.4	63.3	44.0	46.0	64.3	52.3	62.8
	0.6	91.0	67.0	68.0	91.0	73.3	86.8
	0.8	119.0	93.0	95.0	116.3	98.3	118.3
	1.0	–	121.0	124.0	–	117.3	–

From this study, Table III, it would seem that the *maximum pressure* obtainable from a simple cantilever spring with concentrated load is seldom above 50 to 60 grams (1.75 to 2.10 oz.) for practical springs, while the *usual working pressure* is from 2 to 25 grams (0.070 to 0.875 oz.). In the larger springs constructed from wire near 0.030 in. diameter, the pressure for normal displacements may be as great as 150 grams or more (5.25 oz.). These wires with such large displacements would no doubt be much less practicable and for most cases would not be designed into simple auxiliary springs, since the smaller wire and load are usually employed in general practice.

(To be continued.)

CHANGES IN THE BONE OF THE MANDIBLE AND THE TEMPORO-MANDIBULAR JOINT INCIDENT TO THE APPLICATION OF ORTHODONTIC APPLIANCES. SUGGESTION AS TO THE ETIOLOGY OF MANDIBULAR PROTRUSION*

MRS. LILIAN LINDSAY, L.D.S., ENGLAND

ABOUT two years ago Mr. G. Northcroft remarked with his wonted emphasis that it annoyed him to hear the cause of an anomaly ascribed to heredity, for it was obvious that when an anomaly was handed down to posterity there must have been some reason for its appearance in the original ancestor. Again, Mr. Northcroft suggested about a year ago that references to continental literature bearing upon orthodontics might be printed on the billets calling the meetings of this society. Therefore Mr. Northcroft may be considered as the origin of this anomalous discourse. Now, the search into the etiology of an irregularity in man, necessitates an excavation into the past, for man's genealogic tree has its roots deep down in antiquity; and tempting though it may be to dig as deeply as the three great apes—the progenitors of the three types of man: the gorilla or acidotic, the ourang or lymphatic, and the chimpanzee, the mean between these two extremes; tempting as I say it may be, I shall leave that to younger fellow workers of the soil, and only disturb the surface covering the races represented by the long heads and the broad heads.

Dr. Lukomsky,[1] of Moscow, studying the prehistoric grave finds in Russia, states that he found there evidences of a pure or unmixed race whose skulls show no signs of irregularity, caries or pyorrhea—which might suggest to some of us that the Garden of Eden might after all have been planted in the frozen soil of Russia. The trouble arose when the two races mixed, for although the Mendelian law demands that a certain number of the offspring should possess harmonious maxillas and mandibles, the rest would have long narrow maxillas and short mandibles, or short maxillas and long narrow mandibles. The permutations possible to these two combinations are sufficiently numerous to delight even the modern orthodontist.

Drs. Sicher and Krasa[2] made similar observations when examining the skulls in the Vienna Museum, the results of which examination they published in 1920-22. (Figs. 1 and 3.) They measured the skulls and worked out the results. You will see here that one of the facts discovered was that in postnormal occlusion the angle which the ascending ramus makes with the body of the jaw is a right angle, which is regarded as correct for the finished or adult angle, while that obtaining in the prenormal is obtuse or that which is considered as the angle of the infantile or senile jaw. At the end of this investigation Drs. Sicher and Krasa came to the conclusion that the mandible is responsible for all the trouble—

*Transactions of British Society for the Study of Orthodontics.

that is, that it shows an individuality and an independence unique among the bones of the body. This fact was pointed out many years ago by Dr. Sim Wallace, who has always held that the mandible molds the maxilla.

Fig. 1.

Fig. 2.

You are all aware of Oppenheim's[3] experiments; the figures have often been used in papers before this society. Oppenheim was the first to attract attention

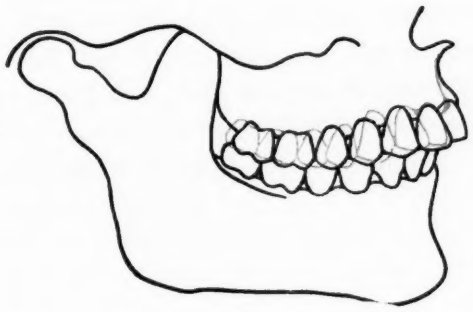


Fig. 3.-*A*.

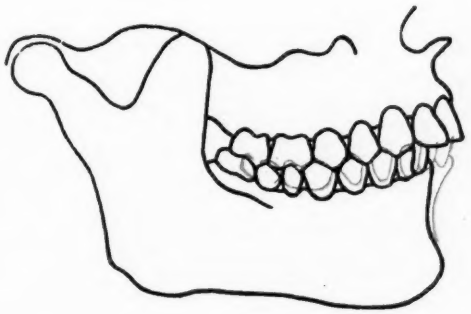


Fig. 3.-*B*.

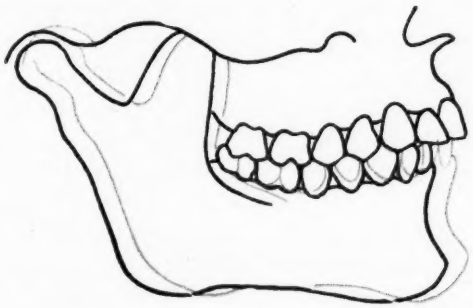


Fig. 3.-*C*.

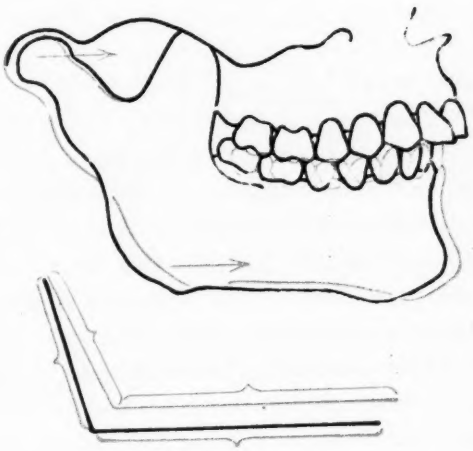


Fig. 3.-*D*.

to the transformation which might take place in the tissues surrounding the teeth as a result of orthodontic measures. He showed that when teeth were moved in certain directions definite changes took place in the alveolar bone, deposition on the tension side and absorption on the pressure side following regularly, according to well-known laws of bone growth and architecture.

But these observations were confined to the bone in immediate contiguity to the tooth or teeth to which the force was applied, and now it has occurred to Carl Breitner,[4] of Vienna, to discover whether the rest of the jaw may not be affected as well as the sockets of the teeth. His first experiments were conducted in order to study the changes that take place during an alteration of the mesiodistal relations of the maxillas and mandibles, such as those occurring in cases of Angle Class II and Class III.

The experiment was confined to a supposed Angle Class II, which was treated by intermaxillary traction by means of rubber bands to act *en bloc* to bring the mandible into a more mesial position.

In such a case there are various ways in which the relations between the two jaws might be altered: (Fig. 3).

(1) The maxillary teeth may be retracted.
(2) The mandibular teeth may be pulled forward:
    (a) By displacement of the teeth themselves in the jaw.
    (b) By bringing forward the whole mandible.
    (c) By artificial stimulation of growth of the mandible, remolding the shape of the jaw.
(3) By a combination of these movements.

Rhesus monkeys were used for the experiment because the temporomandibular joint, as well as the form of the teeth and the occlusion, in these animals approaches most nearly that of man. It was decided to bring the mandible forward *en bloc* by means of metal caps cemented on the teeth from the first molars to the canines on both sides of the mandible. To all of these were soldered buccal tubes to receive a labial arch which touched the incisors and was ligatured to them in such a way as to allow the incisors to tilt. By this means all the teeth comprised in this apparatus were operated upon in the same degree of force. To the caps on the molars were soldered hooks, open toward the back.

The same teeth in the maxilla were fitted with metal caps, with tubes soldered to them to receive a labial arch, which, however, did not touch the incisors. The hooks in the maxilla were soldered to the arch over the canines, and were open toward the front. Rubber bands cut from rubber dam and attached to the hooks, were used for the traction.

The experiment lasted eighty-two days. The bands were removed at meal times and changed daily. The animal was muzzled in between to keep it from removing the apparatus. At the end of the experiment the mandible was in the position of Angle Class III or that of mandibular protrusion.

The histologic examination showed the following:

Changes were seen in the glenoid cavity, on the head of the condyle, in the angle of the jaw, and the alveolar process of the mandible. (Fig. 4.) Absorption was marked by osteoclasts on the anterior part of the glenoid cavity and on

the head of the condyle, this being the side of pressure, whereas on the tension side, that is, the posterior side, active deposition was seen, the trabeculae being arranged parallel to the direction of tension, this arrangement, changing in the direction from behind forward, held until at the anterior part it was finally replaced by absorption seen by the presence of osteoblasts.

The only deduction from this examination is that the glenoid cavity as a whole had moved forward and that the mandible also as a whole had moved mesially.

These changes were not confined to the bone of the joint and the mandible, the cartilage of the joint was undermined by absorption. Thus although the bone

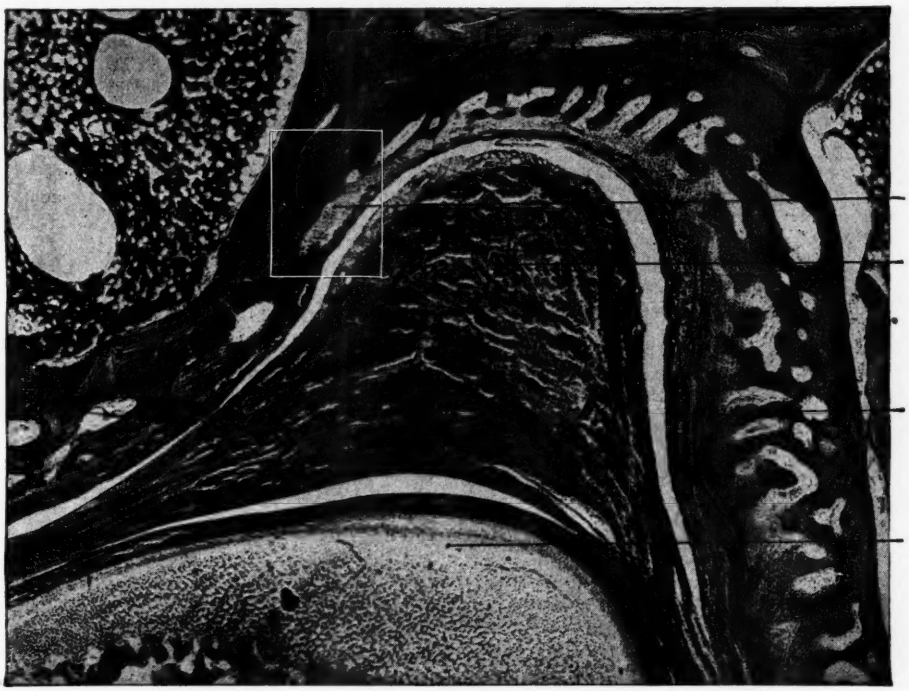


Fig. 4.

of the head of the condyle was absorbed on its anterior aspect, the size of the condyle was unaltered because bone had been deposited on the posterior aspect.

When the same tissues were examined in the control animal, it was found that the bone on the distal side of the condyle ran almost perpendicularly, that is that there was no abnormal absorption, just the ordinary deposition and absorption found in a growing animal. The lengthening of the mandible therefore found its expression in the changed relations of the maxillary and mandible rows of teeth. Since the head of the condyle remained in the glenoid cavity, the change must have taken place in the mandible row of teeth alone; these had taken up an anterior position due to the change of shape of the mandible, further effected by a remolding at the angle of the jaw. Here the histologic picture showed absorption on the outer side and a flattening or enlargement of the angle as a result of which, the length of the ramus remaining the same, the distance of the

ends of the ramus from each other must, necessarily, have increased; the condyle being fixed in the joint, the angle, the other end, must take up a more mesial position.

When the tissues in the vicinity of the capped teeth, that is in the immediate neighborhood of the application of force, were examined, it was seen that changes were taking place there also. The bone trabeculae of the septums and between the roots of the teeth were oriented parallel to the direction of force; deposition on the mesial or tension side and absorption on the distal or pressure side of the septum.

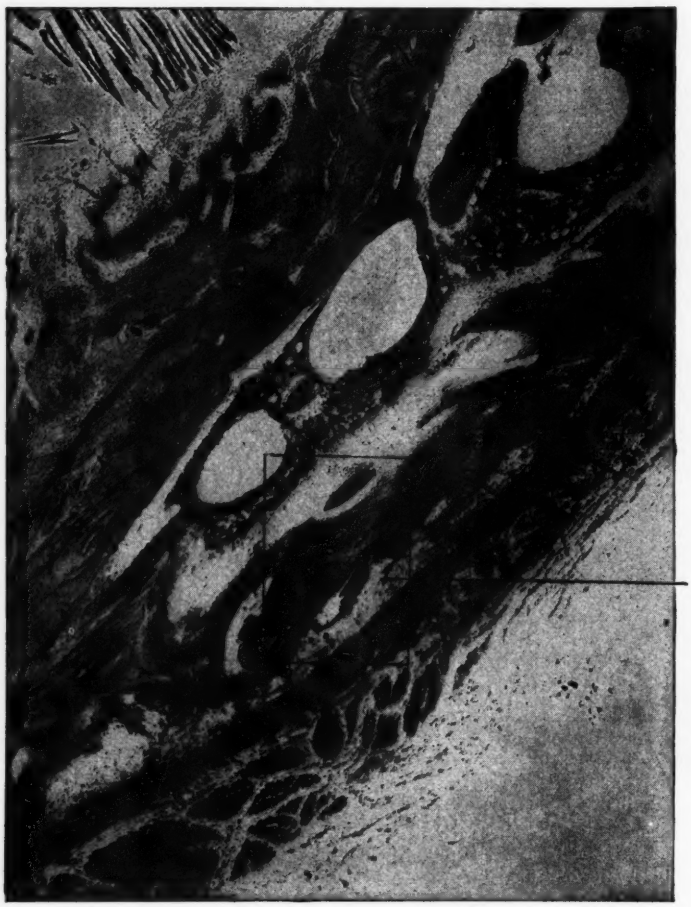


Fig. 5.

There emerges from this that the stronger the anchorage the less will the teeth used for anchorage be affected and the longer the force can be permitted to act on the body of the jaw and the joint until correct occlusion is attained.

And now let me direct your attention to a skull (Fig. 6) which has given rise to considerable speculation. It is in the possession of Mr. B. H. Humble,[5] of Glasgow, who has kindly lent it to me for this meeting. It was shown as a casual communication to the West of Scotland Branch of the British Dental Association last year, with the object of obtaining an explanation of the peculiarity of the angle of the mandible (Fig. 7 and Fig. 8), which, as you see, resembles that of the very young or the very old jaw.

I took the skull first of all to Sir Frank Colyer, who first suggested that it was a case of open-bite owing to the lack of growth in the molar region; but when he examined it more closely he saw that the mandible was almost edge to edge in occlusion. Sir Arthur Keith next saw it and stated that it belonged to a male aged about twenty years. He said it was an example of the modern tendency in jaws to become narrow and that possibly there had been respiratory trouble.

Fig. 6.

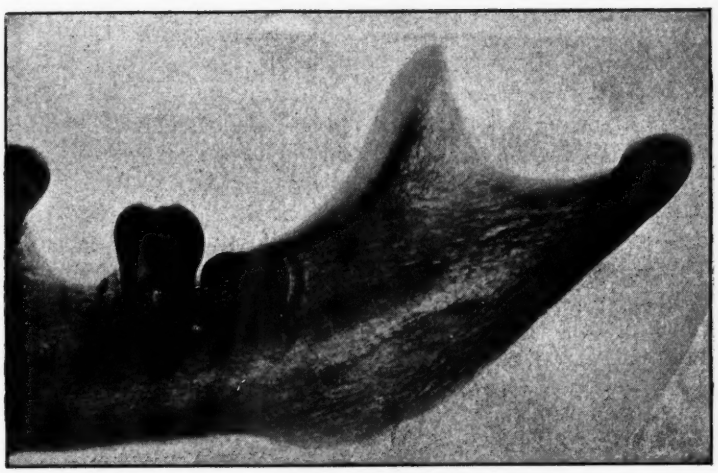


Fig. 7.

Now, if we examine the skull in the light of the experiments on the Rhesus monkeys just shown, it will be seen that the mandible, which may have started by being in retrusion, has been thrust forward until it has assumed its present relation to the maxilla; the glenoid cavity is enlarged and there are distinct signs of absorption at the angle and a remolding of the entire ramus.

I shall now pass to the work of Dr. Robin[6] and the condition, which he has called glossoptosis—in which the mandible is in retrusion and the tongue in con-

sequence too far back in the pharynx to permit of proper respiration or alimentation, as a result of which the individual is badly nourished both in the matter of oxygen for the lungs and food for the body. Now, the cure suggested by Dr. Robin is that of orthostatic feeding from birth—that is, to make the infant stretch its mouth upward and forward in sucking; in this way the same result is obtained

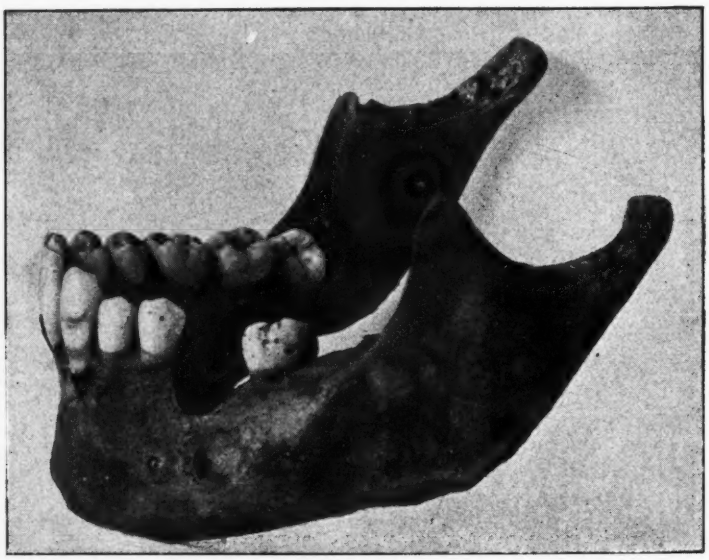


Fig. 8.

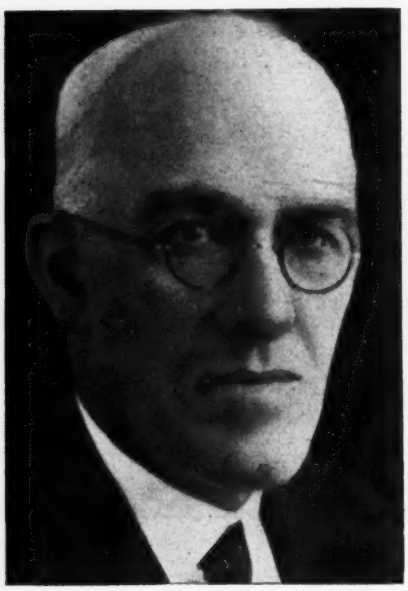


Fig. 9.-*A*.

Fig. 9.-*B*.

as that from the *en bloc* experiment by Carl Breitner. Now, I suggest that where there is interference with respiration, as there must be in all these cases of mandibular retrusion from the position of the mandible with relation to the vertebral column, there must be a conscious or unconscious stretching forward of the mandible to obtain relief, and this will of itself bring about the above described changes.

Another point to note is that changes taking place at the condyle will stimulate growth in length of the whole basal portion of the jaw; for, as Mr. Wilson Charles has pointed out, the condyle is actually an epiphysis for the mandible. This has been corroborated by Schmidhüber[7] in his experiments upon the condyle in puppies.

If you observe cases of mandibular protrusion you will notice a certain heavy look about the face as if there had been at some time respiratory trouble. This is

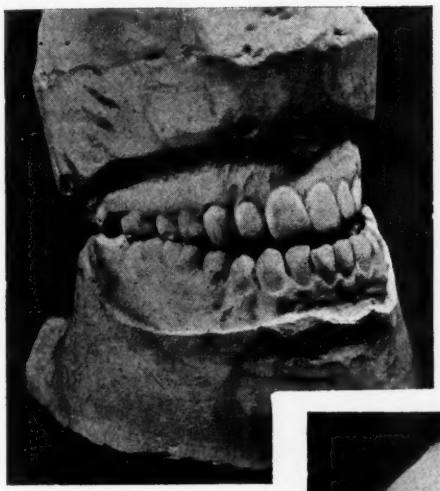


Fig. 10.-*A*.

Fig. 10.-*B*.

Fig. 11.

particularly so in the case of the Medicis and the Habsburgs, whose familial features gave rise to Mr. Northcroft's remark that there must have been a cause for this anomaly in the ancestor of the line. Last autumn, while walking down that long gallery which joins the Uffizi and Pitti palaces in Florence, I noted this fact in the portraits of the Medicis which line the walls. If you look at the portrait of Charles II as a child, to choose only one instance, his adenoidal facies is most marked, and Cosimo III is a glaring case of this.

Now I shall show some cases of inherited mandibular protrusion—two models and three portraits lent to me by Mr. Macdonald Watson, of Bath, who asked me to present these to the museum of this society on his behalf.

Mrs. Lindsay then exhibited models and photographs from practice, lent her by Mr. Macdonald Watson, of Bath. The portrait of the father and cousin of the younger patient exhibited the mandible with typical mandibular protrusion. Models of the maxilla and mandible also illustrated the condition. The

Fig. 12.-*A*.

Fig. 12.-*B*.

photograph of the cousin showed that the irregularity was passed on through the female line, as his mother was the sister of the subject of the first photograph. The son of the first patient showed that the abnormality was passed on through the male line as well; it was far worse in him than in the father or the cousin (Figs. 9, 10 and 11, three portraits and models).

Mrs. Lindsay then illustrated a case in which the opposite condition had occurred (Fig. 12). The patient, a soldier, had been out in France, and in September, 1917 had fallen into an improperly covered shellhole. His comrades had

helped him out, and he had not reported sick for the reason that he was going into rest, but went on with his work. He was transferred to the Italian frontier, where he continued to carry wounded for three months. In December his knees began to give out on the march, and he was forced to report sick. He was taken into hospital and his legs were put into splints for synovitis of both knees. Gradually every joint in his body was attacked, so that he became a complete cripple.

Fig. 12 *B* shows not a jaw injury, but simply osteoarthritis. His jaw was in the position of postnormal occlusion. He said that he was progressing very well, but this was an optimistic view, and he was really in a very bad state.

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DISCUSSION

Mr. G. Northcroft suggested that it would ill become the society to remain silent after the eloquent discourse which Mrs. Lindsay had delivered. He felt proud that he should have been the "etiologic factor" in the production of this paper. The Habsburg jaw, he maintained, was not typical of mandibular protrusion at all, but was really a maxillary retrogression. And "heredity" did not explain the original cause of this condition. Mrs. Lindsay, he said, had stressed the appearance in the Habsburg portraits of probable signs of the adenoid face and also of mouth-breathing; the subjects had probably had both enlarged tonsils and adenoids. It had, however, been suggested many times that enlarged adenoids accompanied the lack of development in the maxilla and were not the cause of the lack of development in the antra, which accompanied the small maxilla. The Habsburgs had flattened cheek-bones and very small antra.

Mr. W. A. Bulleid suggested that he might have completely misunderstood Mrs. Lindsay's reference to acromegalic development, but he had understood her to say that she was inclined to attribute the overgrown mandible to adenoids and to the fact that the mouth was held open. If he was correct, it was a very curious thing that the underhung jaw was rare and that adenoids and mouth-breathing were extremely common. He hoped that Mrs. Lindsay would correct him if he were in error. The question of heredity interested him immensely. Perhaps "heredity" was an unfortunate word, because many people placed different interpretations upon it, and it might be better to use the word "endogenous" exclusively. Mrs. Lindsay, he said, was undoubtedly correct in stressing the fact that definite deformities did pass from father to son in families—in jaws as well as in other parts. Her evidence would support that view, and many orthodontists could bring whole series of models to show that an Angle Class III would pass down many generations.

Mr. Wilson Charles said that he hardly liked to discuss Mrs. Lindsay's paper without first reading it. Nevertheless, Mrs. Lindsay had very kindly mentioned his work and suggested that he had proved that the cartilage of the mandible was in the nature of an epiphysis. He presumed that it might be possible to place this interpretation upon his work on the condyle of the jaw, though it was hardly the interpretation he placed upon it himself. He had seen several references recently to this work; it had been mentioned in a German and in an American paper, and the authors had arrived at a conclusion somewhat different from his own. He

had always stressed the belief that the cartilage found in the mandible was not in any way related to the cartilage which was found in the long bones—for example, the ordinary preformed cartilage of the femur. Fawcett and other authors had remarked that cartilage was found in various parts of the mandible—for example, in the region of the coronoid process and of the articulation—and in the opinion of Nicholson this cartilage was nothing more than what he called a "chondroblast" stage. The condyle therefore contained fibroblasts which differentiated into chondroblasts and then into bone cells, or, alternatively, were replaced by them. At any rate this structure, which was definitely not true cartilage, existed. The point of the whole matter was that the mandible contained a definite wedge of cartilaginous bone. He showed a slide of the mandible of a fairly young jaw, exhibiting the cartilaginous bone which entered the mandible. He remarked that he understood from the works of many writers that they described certain changes which took place around the angle of the jaw. The changes had even been suggested to be due to bending; he asked Mrs. Lindsay for her opinion about this hypothesis. In one slide which she had shown there was, he said, undoubted absorption. He asked whether these changes were due to absorption or—as nearly all English writers had suggested for many years—to a bending of the bone. Professor Brash had, he said, denied the possibility of interstitial growth. If the bone bent, interstitial growth or interstitial change were absolutely necessary. This demonstration was one of his reasons for showing the slide; another was the clear view it gave of the difference between the two classes of structure. Mr. Charles asked leave to put another question to the speaker. The old conception of mandibular growth was, he said, that the bone was absorbed on the anterior surface of the condyle and deposited at the posterior edge. He had been, he thought, the first person to point out that this did not occur. He emphasized that, in the specimens which Mrs. Lindsay had shown, absorption had taken place on the anterior surface of the condyle, when the whole mandible was brought forward, and also on the posterior edge. This was an abnormal condition. He had demonstrated before in a similar connection that under perfectly normal conditions no pressure took place at the condyle. It was usually considered that the condyle acted as a fulcrum during mastication; this was not so. In the normal condyle bone deposition took place back and front.

Mr. Robert Cutler said that it was fitting to congratulate Mrs. Lindsay on having so ably tackled a subject of such tremendous practical as well as theoretical possibilities. Her paper must inevitably be of great interest to all sections of the society. He felt that the society was divided into two main sections. On the one hand there were the older men whose fame and fortune were firmly established and who could afford to browse in the Olympian fields of academic theory and speculation; to such members the paper this evening had a peculiar appeal. On the other hand, the society contained an ever-increasing section of younger men whose fame, and certainly whose fortune, had yet—if ever—to be made and who were crying out for a lead in the simpler problems of technic in treatment as well. For many reasons there must always be a gulf between these two essential sections of the society. One reason was, possibly, that veteran specialists had progressed so far in their knowledge and their technic that they possibly no longer fully appreciated the orthodontic growing-pains and the dreadful apprehensions of the young practitioner with no specialist experience who was called upon to take some step in treatment from which there could be no withdrawal. It was the peculiar responsibility of their work that they must go forward to success or to failure, and not, like the prosthetist, make renewed attempts if the first was unsuccessful. To these younger members Mrs. Lindsay's paper brought up an important question of technic in treatment: were there real grounds for believing that postnormality could be permanently corrected in Class II children, say, beyond the age of seven or eight years, if so, when and how; and if not, why not? Mrs. Lindsay had very ably postulated the various possibilities that might occur in the successful correction of this condition. He did not desire to elaborate her remarks. There were, indeed, many points of difficulty in the investigation of changes which actually occurred in the jaw; one was the trouble necessary to secure good x-ray pictures of the temporomandibular joint. In Class II cases where treatment was commenced early the permanence of the correction suggested that changes must occur in the architecture of the bone or of the joint. In the maturer cases, where treatment was commenced at the age of nine or ten years, a postural slinging forward of the mandible must first be established, and he felt that secondary changes

occurred in the joint at a later stage, though what these were the eye of no man had seen. He pointed out that Mr. W. Kelsey Fry—one of the most practical members of the profession and a member of the society—had put on record that in cases cured in this way relapse always occurred when the teeth were removed in their entirety, when the question of dentures was considered. Mr. Cutler adduced one case which illustrated this point. He handed to the President illustrations of a case of a postnormal occlusion occurring in a normal boy with a broad maxillary intercanine space and ample room for all his teeth. This was a case from Guy's Hospital, under the directorship of Mr. Bull and was exhibited with his permission. Mr. Bull had suggested treating the case by a maxillary anterior incline to bring the mandible forward. This had been employed, but when the excess incisor bite had been lifted the mandible had not come forward into its normal position. Films of the mandible showed the joint and the occlusion of the teeth. Afterward, following up the anterior inclined biting plate, Mr. Cutler had applied intermaxillary traction for a period of six weeks only; this had established a normal relationship of the jaws, obviously owing to a postural swinging-forward only. After six weeks the boy had been biting forward into the typical Class I position. He had therefore removed the fixed appliance and had put in a simple maxillary plate with a retention anterior incline. The boy now bit in a normal position either with or without the plate; far more important, he bit and held his jaw in that position when he was not being observed. Further x-ray pictures had been taken which showed, on the right side, that the occlusion of the molar teeth was now normal and that postabnormality had been corrected; also that the head of the condyle was now not fully bedded into the temporomandibular joint, but was pressed hard against the posterior aspect of the eminentia. The x-ray pictures showed precisely the same condition on the left side. This case opened a question of technic in treatment: whether the case was going to relapse. He asked for Mrs. Lindsay's views on whether a change in the architecture of the bone, which would bring about a permanent result, was likely to take place.

Mr. Bull inquired how much reliance Mrs. Lindsay placed upon the old engravings she had described; considering the furore that was raging at the present time round the Earl Haig statue and its artist, this was rather an important factor. Many of these pictures had simply been made for the benefit of the individual who was painted; they might not be quite accurate representations. He could not well imagine how anybody could wish to have such ugly representations of himself handed down to posterity.

Mr. H. G. Watkin added his thanks to Mrs. Lindsay for what he described as a particularly excellent paper. It had especially interested him because he had treated a case of mandibular protrusion some eighteen months before. Surgical means seemed to be the only practical ones. The patient—whom he had treated in collaboration with Mr. Simpson—had written to him three weeks before in complimentary terms.

The *President* expressed his appreciation of Mrs. Lindsay's paper, which raised many questions of great interest. In making accessible to them the work of foreign authors of whom they could not always know because they did not possess her linguistic ability, she had done them a very great service. Her paper had been divided into two sections: the possibility of bone change, particularly applicable to postnormal occlusion, and the extremely interesting problem of mandibular protrusion. With regard to the first question: the changes that might occur when the jaw was advanced; this was one of perennial interest. Mr. Cutler's x-ray films had been distinctly disappointing. It was undoubted that, when an inclined plane had been put in and the bite had come forward, the condyle appeared to be in the glenoid cavity when the teeth were in contact. It was equally true that, before treatment is commenced, when the mandible is advanced so that the teeth are in normal occlusion, the condyle rests on the eminentia articularis. Some change must occur, and the president had always assumed that it must be some change of bone growth in the ascending ramus, conceivably due to bending. However, as Mr. Cutler said, the x-ray pictures did not seem to bear out that contention, because they seemed to show that the condyle was permanently advanced. It was a little doubtful whether permanent changes occurred in the bone, because relapse could occur. One of his patients, the daughter of a doctor, had given a particularly clear description of the treatment which had been applied to her, and there had been no doubt that she had used an inclined plane

for postnormal occlusion. She had worn it for some years. She had informed the president that the treatment had been quite successful, but when he had seen her, she had lost many teeth and the jaw had returned to the postnormal position. She had told him that the whole bite had relapsed when she had had her first baby. That being so, it seemed to him difficult to imagine that permanent changes could occur. Mr. W. H. Dolamore had suggested some years before that changes might occur in the ligaments, rather than in the bone. He had, he said, been very much interested by Mrs. Lindsay's remarks about the work of Robin. He had read many papers by this author and had not always found it easy to understand what he was driving at, but his work seemed to provide a long-sought picture of the etiology of postnormal occlusion and to show the conditions that might occur before eruption of the teeth. The president had inquired of many pediatricians, but none had seen children who choked if laid on their backs, as was said to occur in this condition of glossoptosis. He had read a paper in the *Acta Scandinavica Paediatrica* by an authority who described cases of hypoplasia of the mandible in children who had choking fits when laid on their backs, and the pictures showed what was undoubtedly mandibular retrusion; they were, however, all examples of cleft palate. Writers in America had described cases in one of which actual suffocation had occurred, the postmortem examination showing mandibular retrusion. The view had been expressed that postnormal occlusion or mandibular retrusion was not necessarily bound up with the condition of cleft palate but was an independent anomaly. He had seen a large number of babies with cleft palate but had never been able to observe that they had mandibular retrusion. They were still far from any solution of the etiology of mandibular protrusion. It was all very well to say that heredity did not explain the condition, but the fact remained that it was one of the few types of irregularities of the teeth which were perpetuated, and perhaps an explanation could be found in the Mendelian theory. Professor Cunningham had read a paper some years ago on heredity, and Dr. Cockayne had attended and shown a large number of slides of irregularities of the teeth and jaw which had been definitely propagated. According to the Mendelian view, it was definitely not a sex-linked condition, but he agreed with Mr. Northcroft that in some of these recorded cases confusion had probably occurred in the interpretation of the picture, and they had been assumed to be real cases of mandibular protrusion, when in reality some of them were examples of maxillary retrusion. Some of the pictures that had been shown that evening removed any doubt that the condition was a maxillary retrusion and not a true mandibular protrusion. Professor Bolk of Amsterdam, in the course of some lectures delivered in this country some years ago, had dealt with the question of endocrine glands in evolution; he had pointed out that in the chimpanzee the fetal condition was orthognathism and that prognathism only developed later, and had suggested that the latter condition was due to the development of the pituitary body. He had put forward the hypothesis that the evolution of the anthropoid apes was conditioned by endocrine activity, and that the same position occurred in man after birth that was a fetal and transitory condition in the anthropoids. This suggestion raised the interesting question—which was probably supported by other evidence—that definite cases of mandibular protrusion were caused by some overactivity of the pituitary body. He was not prepared to say whether they could go further and maintain that some cases of underdevelopment of either the maxilla or of the mandible were associated with an underactivity of the pituitary body, but the point made by Professor Bolk was certainly an interesting one.

Mrs. Lindsay, in reply, said she had tried to emphasize the question of heredity and that the ancestor of the Habsburg type had probably suffered from some kind of respiratory trouble which had caused the peculiar flattening of the maxilla; perhaps Jeanne la Folle, daughter of Ferdinand and Isabella of Spain, had inherited the small narrow maxilla from the long-headed race. Mrs. Lindsay did not wish to say that adenoids had anything to do with the condition, but when an observer saw an adenoidal countenance he concluded that respiratory trouble existed. The president had referred to a case—she thought in 1923—seen by a dentist[8] in Bristol, of two sisters with complete closure of the choanae and extensive adenoids, whose jaws were nevertheless well developed; adenoids therefore had nothing to do with this condition. She had only shown that the Habsburgs had had respiratory trouble, and had probably thrown forward their mandible and altered the condyles and the angle at which the ascending ramus

met the body of the jaw. Once that type had been fixed, it was handed down. This was the point at which heredity came in; heredity was not the cause, the cause had come in the ancestor.

She did not think that bending occurred. Dr. Breitner had, she thought, shown that complete transformation and reconstruction of that part of the mandible took place, and that this stimulated growth in the length of the mandible. When pressure took place under the condyle, a stimulation of growth occurred—if that was the growing part of the jaw, as Dr. Schmidhüber had seemed to prove in his experiments. The skull which she had exhibited showed the point which Mr. Cutler had made: the eminentia articularis had almost completely disappeared, and the man must have thrown his jaw forward constantly resulting in a reconstruction. The head of the condyle was very much absorbed and had definitely come forward.

On the effect of extraction, her experience showed that, if the mandible had been thrown forward, it was almost impossible in later life to keep the mandibular arch behind the maxillary. The mandible seemed to continue to grow forward even in old age.

In reply to Mr. Bull, she did not think the court painter would have painted these features unless they had been there. He would not have made, as Mr. Bull had said, such ugly pictures, but would have tried to make them handsome. Moreover, they were so numerous. She invited any of the meeting who were ever in Florence to look at these rows of portraits, all very much alike; no observer could avoid remarking on the heavy open mouth and mandible with, here and there, a very marked Class II. She had been interested to see the adenoidal child Charles II develop into the man with mandibular protrusion.

She showed the book which Dr. Robin had published entitled *Glossoptosis*. This work illustrated adults, as well as children, with the monoblock. Robin contended that he could alter the glenoid cavity in them. The change involved not only the ligament but the whole bone of the joint.

On the question of endocrines, Professor Sir Arthur Keith had spoken of Darwin's theory of parthenogenesis as foreshadowing the theory of endocrine influence, in that it was a streaming out from all the tissues and some kind of hidden stimulus passing on the acquired characteristic to the offspring.

FACTORS TO BE CONSIDERED IN THE DIAGNOSIS OF MALOCCLUSION*

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THE development of an art or science is slow and laborious. A newly discovered fact is often acclaimed the solution of all problems in that field. In reality the new discovery merely elucidates the old and in due time fits into the scheme of the whole. Its growth is comparable to that of a living body in that it is not continuous and synchronal but a series of intermittant starts and inhibitions. At the present time we are in the midst of a surge of unfoldment in that phase of orthodontia dealing with the etiology of malocclusion which comes after a prolonged period of evolution in the mechanical field.

Although orthodontia is relatively young, malocclusion of the teeth is almost as old as man. Malocclusions of the teeth have been found in the remains of postglacial man and are present in people of practically every known civilization. The ancients were aware of the irregularity of teeth as is revealed in the literature of their time and which abounds in references to the beauty and evenness of the teeth. These references are of much historical significance because they portray the thoughts of those ancient people, but they are of little or no scientific value. Hippocrates in his sixth book *Epidemics* says, "Among those individuals whose heads are long shaped, some have thick necks, strong members and bones: others have strongly arched palates, their teeth are disposed irregularly, crowding one on the other, and they are molested by headaches and otorrhea."

Passing to more recent times, namely, the last two hundred years, the observations and reflections recorded direct a more inquisitive attitude toward the causes of the malocclusion of teeth. Fauchard in his book published in 1728 developed some thought relative to the causes and treatment. His treatise is the first authentic record on the treatment of malocclusion. Following him Hunter, Lefoulon, Fox, Desiabode and others made valuable contributions.

Although the collection of causes was slow and vacillating, it was nevertheless fruitful in its results; many causes were found and speculated on. As these facts were uncovered they were not organized so that they might be used as a whole; therefore, diagnosis was speculative and unsound.

Near the close of the nineteenth century the knowledge related to the causes and treatment of malocclusion was correlated and classified. This fact made these basic principles teachable, but probably still more significant was the realization that before malocclusion could be studied intelligently, normal occlusion must be recognized.

The diagnosis of malocclusion is built on the same premise as the diagnosis of any other pathologic or maldevelopmental process in any part of the living organism; namely, first, a thorough comprehension of the normal, both in the

*Presented to the American Board of Orthodontia, May, 1932.

embryologic and in the developing organism; second, the degree of perversion from the normal; third, the causes responsible; and fourth, whether the causes responsible are still effective. When these factors are understood in making a diagnosis, the prognosis becomes more favorable. If treatment is indicated, it may be instituted with a definite goal in sight which is the normal or something approximating it.

In normal occlusion there is a classical relationship of the cusps, but a variation in arch form, depth of overbite, and in the relationship of the jaws and face to the brain case. Taking this as a basis the occlusal divergence from the normal may be determined by the Angle occlusal classification consisting of Classes I, II, and III. In Class I there is a normal mesiodistal relationship of the mandibular arch to the maxillary arch. In Class II there is a distal relationship of the mandibular arch to the maxillary arch, and in Class III there is mesial relationship of the mandibular arch to the maxillary arch. This classification with its subclasses, when determined, will indicate how far the perversity has progressed in the anteroposterior direction and will materially assist in making a diagnosis and indicating treatment when combined with other etiologic factors.

Meditating on the development of medicine and dentistry, one can repeatedly find where a disease or disorder of a certain part of the body has proved to be an enigma, and treatment was emperical, until some observer found the causes responsible for the condition. When these facts were established a more positive treatment was soon formulated. A situation in which this may be true is ideal but many times impossible. It is not always possible to find all of the causes of a malocclusion, but a diligent search should be made, because it is only through recognition of them that their effectiveness can be determined.

Before considering a classification of the causes of malocclusion it may be advisable to review the six cardinal forces which maintain normal occlusion. They are: influence of the inclined planes, approximal contact, harmony in the size of the dental arches, muscular balance, atmospheric pressure, and cell metabolism. Should any of these forces be disturbed, the whole masticatory mechanism and associated parts will tend to become unbalanced, because the interception of any one force incites a malocclusion that is progressive and in time disturbs more than one of these forces.

In the discussion of the causes of malocclusion I shall consider them according to the time and the manner of their occurrence. From the standpoint of time the causes of malocclusion may be inherited, congenital or acquired. The manner in which a cause may appear must be either local or constitutional. At the time of the union of the male and the female germ cells the hereditary traits and characters of an individual are potentially established, but their ultimate expression will depend upon the prenatal and postnatal environments of the individual. After this time they may be operative or inoperative depending upon the prenatal and postnatal environment of the individual. Physiologic and morphologic characters such as metabolic rate, activity of endocrine glands, color of hair, eyes, shape of teeth, etc., are transmitted from one generation to another, but may remain dormant for two or three generations. The reasons for this may be explained by Mendel's law. Therefore, normal hereditary characters may be easily detected, but abnormal characters when manifested are more obscure.

When the complexity of development and function of the dental apparatus is considered, it is possible to conceive a circumstance where the perversion of the occlusion may be attributable to hereditary malfunction and maldevelopment of other parts. Familiarity with all of these possibilities leads one to be cautious in designating a cause as of genotypic origin. Another reason for cautiousness in arriving at a decision is the meager knowledge concerning the hereditary possibilities of malocclusion due to the length of human life and the inability to obtain sufficiently accurate geneologic charts.

Congenital causes are those factors resulting from a poorly adjusted environment during the period of intrauterine life. True, individuals may develop normally in spite of unfavorable environment, but it cannot be denied that nature functions most smoothly when favorable conditions prevail. Experimental biologists have shown that at certain periods in the intrauterine growth of various organs a change in the developmental rate, due to abnormal temperature, improper food supply and an inadequate provision of oxygen, may prevent morphologic and functional perfection. The practice of modern obstetrics takes cognizance of these facts, and the obstetrician endeavors to prevent an unbalance in the factors of development and growth during the care of an expectant mother. During a certain stage of embryologic life clefts in the upper lip and maxillae are normal, but should some disturbing factor interfere with development at its critical period and change the developmental rate the clefts may fail to close, and from a functional and morphologic standpoint the result will be abnormal. Any detrimental factors retarding normal growth at this time as well as after birth may prevent the full realization of its predetermined possibilities.

Acquired causes arise after birth and are of environmental origin; therefore, should a disturbing factor exert enough influence it is possible for an individual to develop a malocclusion at any time during life.

The probability that all conditions, particularly congenital and acquired causes, are dependent for their expression upon environment, makes it possible to classify them as of either local or constitutional origin.

Local causes are those which produce malocclusion by affecting the teeth and surrounding tissues in a direct manner. Constitutional causes are those which so disturb the general metabolism of the individual as to influence the development of the teeth and adjacent structures.

Having briefly considered the classification of the etiologic factors of malocclusion, I shall now consider some of the causes that may be grouped under hereditary or congenital origin. First, a cause which is often overlooked but which invariably produces malocclusion is that of supernumerary teeth. This condition is more common than is usually supposed. Supernumerary teeth are most often found in the incisor region of the maxilla, but they may also appear in other locations. They are frequently found between the maxillary second premolar and the first molar. Whenever a tooth has sufficient space in the dental arch and is displaced or deflected, the presence of supernumerary teeth should be suspected. There may be one or as many as seven in the one area. This can be confirmed by radiographic examination.

When the supernumerary teeth are removed, successful treatment will be fairly certain provided other factors do not interfere. If they are noticed and removed before the tooth is greatly deflected, treatment may not be necessary, but the case should be kept under observation.

Concerning maldeveloped, missing and transposed teeth, much need not be said except that they invariably are forerunners of malocclusion because they are usually abnormal in their approximal and cusp relationships with the other teeth.

Malocclusion is always associated with cleft palate and hairlip. This condition, as stated above, is due to congenital disturbances. Orthodontic treatment is very difficult in these cases because of the partial or total destruction of the tooth germs in the region of the cleft.

Although enlargement of the frenum labium may be found in either the maxilla or mandible, it is more common in the maxilla. It is quite usual for a very young child to exhibit a large frenum, but should this continue after the eighth or ninth year or after the canines begin to take their position in the arch, it may prevent the incisors from establishing proximal contact. In the light of present knowledge concerning this problem, surgical removal of the frenum is usually unwarranted. The approximation and reasonable retention of the central incisor teeth by orthodontic means are usually all that is necessary.

In discussing the acquired causes, such as the early loss of deciduous and permanent teeth, the late retention of deciduous teeth, impactions, dental caries, vicious habits, it need only be said that these are purely mechanical disturbances but are probably the cause of the majority of malocclusions. Over this group the general practitioner should reign supreme, because if he has a comprehension of them and uses his knowledge to apply preventive measures, he can determine whether or not his patients will become potential candidates for orthodontic treatment.

The effect of mouth-breathing as a contributing factor in causing a malocclusion has long been considered. It is true that if this habit is tolerated, the inevitable result will be a malocclusion. There will be a protrusion of the anterior maxillary teeth, narrow maxillary arch, short upper lip, and a retruding and undeveloped mandible. This condition is associated with hypertrophied tissue in the nasopharynx.

The malfunction of the endocrine glands is now recognized as an etiologic factor in some types of malocclusion. These physiologic regulators, several of which have been recognized, exert their influence through the hormone which they secrete. These hormones or enzymes act as accelerators or inhibitors of development, growth and of function in the various organs of the body. Often they collaborate in producing a result; sometimes their action is antagonistic, one acting as governor of the other. Their scope of action is large, for it is presumed that they control development and growth, the metabolic rate, and the metamorphosis from infant to adult forms. Due to their location and to the fact that they may act singly or in combination, their function is difficult to study.

In the study of the endocrine glands as related to malocclusion, probably the two that are of most concern are the thyroid and pituitary, because they are

more easily associated with development and growth. Anthropologists in studying the relationship of endocrines to development and growth have stated that many cases of malocclusion, such as undeveloped arches, which the orthodontist has attributed to local causative factors, are the result of arrested growth due to the malfunction of these physiologic regulators. It is not uncommon to observe a normal occlusion in a child three or four years of age and a year or two later to notice a protruding mandible for no apparent reason. In some cases the open-bite may also be associated with a derangement in the secretion of the endocrine glands. When this condition is suspected, the only conclusive test is a thorough medical examination, for to attempt orthodontic treatment without first placing these physiologic regulators into normal function cannot help but lead to an embarrassing situation.

Exanthematous diseases, namely, measles, chickenpox, scarlet fever, smallpox, etc., because of their symptomatic fever may cause temporary arrests in the calcification of enamel and dentine, and thus cause hypoplasia of the enamel and dentine. Hypoplastic teeth are often forerunners of malocclusion because of their loss of approximal contact and inclined planes. Hypoplasia of the teeth may also be caused by nutritional, congenital or syphilitic disturbances.

Another common constitutional disorder is malnutrition and its subsequent diseases. In the past it was thought that if the food ingested contained proteins, carbohydrates and fats, it was sufficient. The science of nutrition now teaches that in addition to these substances a good diet must also contain adequate amounts of water, mineral salts and those accessory food substances called vitamins. This science also demonstrates that the type and construction of proteins are of the utmost importance because of their combinations of amino acids, of which eighteen or twenty are known to enter into the composition of protein, they are suitable or unsuitable for the best nutrition. While proteins are chiefly tissue building materials, they may also provide oxidizable material for energy, although fats and carbohydrates do this readily and much more economically. Therefore, fats and carbohydrates are valuable in a diet because they spare protein for tissue building and also assist in the absorption of mineral salts.

Mineral salts are absolutely essential if a body is to function and grow. There are about twenty of them found in the body, and of these there are three that have a direct bearing in our work. The bulk of the bony framework and of the teeth consists of calcium and phosphorus in combination as calcium phosphate. Iron is also important for it enters into the formation of hemoglobin, which carries oxygen to the tissues and which is an essential element in growth.

Growth without the vitamins cannot be normal. There are six of these accessory food substances recognized, A to G, inclusive; each has a definite sphere of action, but the action of each influences the action of all of the others.

A balanced diet must contain all of the vitamins at all times, for the superabundance of one cannot remedy the derangement caused by the lack of another. If, at any time during a child's growth, there is an inadequate supply of any vitamin, the growth processes will be retarded and altered, and should this occur during a critical time the form and character of structure may be changed and so remain during the lifetime of the individual. This has been demonstrated

in children suffering from rickets, a disease caused by the lack of vitamins. In the cases where this disease has run rampant in early life normal structural changes have often been perverted, namely, a delayed deciduous dentition, thickened alveolar ridges, and a flaring of the lower border of the mandible which is due to the pull of the submandibular muscles on the extremely plastic bone. In these cases tooth formation is often poor, and experience teaches us that the character of bone is definitely changed because the teeth of such patients are easily moved but the retention of the teeth in their new position is extremely difficult.

Many other disorders result from a deficiency of the other vitamins which exert a direct or indirect influence in causing malocclusion, but time will not permit a discussion of them. Nevertheless, they must be considered when making a diagnosis.

In this discussion of the causes of malocclusion many causes and much detail have of necessity been omitted, but, nevertheless, a thorough and broad understanding of the biologic problems in orthodontia is necessary before an intelligent diagnosis can be made. Treatment at best can only be successful in proportion to the diagnosis preceding it in any given case, for a skillful treatment based on an unintelligent diagnosis is speculative.

The search for these etiologic factors of malocclusion must be organized on a systematic basis. It should be a routine procedure with each and every case.

All aids that tend to strengthen the dragnet must be employed, and those commonly used are: first, a thorough case history of oral and general conditions; second, an accurate set of orthodontic casts; third, a careful mouth examination; fourth, a full radiographic survey of the jaws; fifth, photographs of the face in the full front and full side views; and sixth, a medical examination by a physician when deemed necessary.

It can readily be seen that in using such a procedure, the chances for error are minimized, and knowledge based on facts supplants that based on presumption.

In conclusion, it appears to me that a broad and comprehensive understanding of the biologic problems is necessary, because it is only through this manner that our treatment can remain an enduring benefit to the patient and because it holds open the gate to the Utopia of both medicine and dentistry, namely, *prevention.*

APPLIANCES*

JOSEPH D. EBY, D.D.S., NEW YORK, N. Y.

THE spring of 1932 brings with it the thirtieth year for my first orthodontic appliance, and this is the story of some of my experiences, observations and beliefs. I have not consulted any authorities or records, and I propose to give only my own personal opinions, assuming the responsibility for their accuracy or inaccuracy, which you may accept or reject, as you see fit, without hurting my feelings.

In making this statement modestly, I do not propose to set myself up as a patriarch of appliances, and I am sure there are many men in this audience whose first appliance would precede this date by a good margin. What I have to relate may not be interesting to the older men, but I hope the trend of things as shown will serve as a guide to those of more recent experience, and I firmly believe that any prophecies which may be suggested will come true.

Prior to 1903, according to my personal impressions, orthodontia as a practice was almost entirely in the hands of the individual dentist. It was known that teeth did move and could be moved, but the why's and the how's were limited and vague. It was supposed that bone was an elastic substance which yielded to stress and strain, and the method adopted in the form of appliances was largely the result of the ingenuity of the individual operator.

The names of the foremost men of this period are known to history, but in 1903 I gained the impression that with some few exceptions the practice of orthodontia was then vested in the principles advocated mostly by Doctors Edward H. Angle, Calvin S. Case and Victor Hugo Jackson. I do not mean to detract from other great men who were active then, or those who having gone before left their work to be built upon and added to.

Angle, Case and Jackson stood for definite systems which were largely original with them. They were exclusive, different and characteristic. There were other systems, some patented, some procurable on the market, but not sufficiently distinctive but that they could be more or less traceable as variations of similar principles.

Some appliances could be purchased at the dental depot, and with a certain amount of office equipment the operator was ready for work. Other appliances were mostly stock parts, which had to be made by the operator or in a laboratory. This entailed many tap and die plates, dies, counter dies, molds, and such. Other equipment consisted of certain raw materials, a few wire-bending instruments, blowpipes, soldering irons, and a gold-plating outfit.

There were innumerable other appliances identified with different men's names, and many without identity.

*Read at the annual meeting of the New York Society of Orthodontists, March 9, 1932.

The first appliance I made consisted of a removable vulcanite cap which covered all the maxillary posterior teeth and the palate and was reinforced to extra thickness behind the maxillary incisors. Holes were drilled and threaded for screws which were designed to press the retruding incisors outward. It did not fit.

The second appliance consisted of two vulcanite caps covering the posterior teeth to the cervical margins from the canines back, with two Angle jackscrews running straight across the palate for expansion. This was cemented to position.

These devices were common. Another typical one was a complete maxillary removable vulcanite cap with a half-round 16 gauge "clasp metal" wire hooked around a buccally erupted canine, supposedly to push it into position, whether there was sufficient space or not. There were many other maxillary and mandibular appliances, all crude.

For several years following this, the rule of adjustment for all appliances was to see the patient twice a week, and lucky indeed, was the boy or girl thus afflicted who could go but once a week. In such an instance the patient or parent had a wrench at home. He was told to tighten the nuts perhaps every day. The Coffin split plate with its convoluted piano spring wire was gradually passing out of use. I always enjoyed making those funny fellows. The split rubber was nothing, but the spring interested me.

The Angle appliance consisted of adjustable molar anchor bands and expansion alignment arches, made of base metal and gold plated. Some were plain and some were ribbed for the cutting of notches to hold the ligatures. This appliance was readily accessible and within the scope of practically every dentist to set the bands and tie the arch in with ligatures after one fashion or another.

The parts of Dr. Case's appliances were more numerous. The designs were always very beautiful to me, carefully planned and for definite purposes, but the technic was difficult.

Dr. Jackson's system could be readily practiced, if chosen. Some base metal plate, nickel silver wire, pliers and soft soldering equipment were required. The stumblingblock of the Jackson system in those days was the necessity for accuracy of it, which required real skill in the art of wire bending.

As time rolled along, almost every year marked some general progress. Dr. Hinman, under whom I was studying, gradually eliminated vulcanite except for retainers. He used a few designs of Dr. Case's appliances, or their principles, for certain cases, but his work eventually became about equally divided between Angle and Jackson appliances.

I recall in 1905 a case in which the mandibular arch was normal. The maxillary arch was normal in form and occlusal relation on the left side, but a buccally erupted canine had lost its space by the anterior migration of the right maxillary posterior teeth.

The appliance made for that case consisted of banding all of those right maxillary posterior teeth and then every alternate tooth in the rest of the arch. Horizontal 16 gauge tubes about an eighth of an inch long were soldered to the

buccal and lingual surfaces of the four right maxillary bands. To the other bands were soldered inner and outer arch wires with long, free threaded ends, which were to be run through the tubes on the right maxillary bands with a nut in front of each tube.

This made eight nuts to be tightened against those four defenseless right maxillary teeth which had first to be separated far enough to get two thicknesses of band material between them. All of this represented quite a triumph in construction and eleven bands to be cemented on at one time, not to speak of the suffering of the patient.

Those nuts were tightened twice a week, and I wish to assure you that the teeth moved back! Something had to move, but I have shuddered at the thought of what happened to the investing tissues.

These experiences were bringing lessons, all hard, some reasonably pleasant, and many very bitter and discouraging.

I have never seen a single appliance which did not eventually prove its own effectiveness and something of the skill and knowledge of the operator behind it. It seemed to be a contest between stability and instability, flexibility and inflexibility, the wits of men pitted against the laws of nature, and nature with her many hidden secrets holding the upper hand.

My inexperienced mind developed a liking for springs as a medium of pressure in preference to nuts, ligatures and similar devices. The one was an intermittent force, starting with a maximum and diminishing to nothing, only to be repeated; whereas, the spring was a constant force beginning with a minimum and following progressively the movement of the teeth up to its maximum capacity, and maybe the tooth moved beyond it. There has never been a period in my life, in spite of many ardent advocates, in which I could reconcile my mind to the drastic measures of powerful intermittent forces.

As time rolled along, through 1907, 1908, 1909, 1910, I became quite expert at the making of Jackson appliances; and if I have made only a bushel of them in my day, I am sure it would be a heaping one. They possessed the principle and value of the spring crudely expressed as a preferred substitute for a nut, but the early Jackson appliance lacked exactly what the fixed appliances had, which was stability of anchorage. You could never tell within a millimeter or two how far up or down the Jackson appliance would vary from one insertion to the next, so that the stresses created would have depressing, elongating, or, to say the least, discouraging results on the teeth, often moving them in almost any direction except the one desired.

The failure of children and parents to cooperate in keeping any removable appliances on the teeth is a constant element of failure. Dr. Jackson finally stabilized his anchorage by making what he called "collars" with buccal lugs for certain teeth, the patient not to remove the appliance.

No one discussed much what happened in the tissues when teeth moved, largely because they did not know. Most men thought that if they could spring the bone and hold the teeth long enough, the bone would gradually adjust itself. Others propounded the idea that there was a certain breaking down of the or-

ganized structure which would eventually integrate itself back to normal around the transposed teeth and keep them there.

It was when Dr. Oppenheim of Vienna presented his research, showing a microscopic study of the changes in bone incident to tooth movement, that the profession began to sit up and take notice. A great impetus to progress in appliances was the establishment of the Angle School of Orthodontia as it was conducted from 1901 to 1911.

The vital laws attending growth and development of the face were associated with malocclusion of the teeth. The studies of cause and effect and the classification of malocclusions added direction to planning a case. Treatment became more prescribed in type and of great importance; technic was made definite in detail. Appliance principles became better understood.

Orthodontia and the service it will render in the future should never cease to pay homage to those men who specialized in exclusive practice prior to 1910. They were true pioneers, and the value of their work can be measured by what they did prior to 1910, plus the vast progressive work they have done since, and the constructive influence they have had on the contributions of the many who have followed them.

About the time of Oppenheim's reports the vision of orthodontia began to clear. Men seemed suddenly to realize that they were dealing with living, changing tissue. The words "dynamics," "power," "force," "expansion" as in a sense of tearing something apart, and many of the more harsh terms which were constant expressions, began to be toned down. I shall never forget one time when Dr. Hinman was quizzing a class, he asked a student what were the different ways for moving a tooth. The fellow answered "pull and shove," and he was almost right.

While the Angle expansion arch remained effective, as it is even today, all the rest of the early Angle parts including jackscrews passed on. The first radical change was the pin and tube appliance, which represented more of a spring; and following that, the ribbon arch, ribbon arch midget; and last, the edgewise appliance.

I had certainly suffered sufficient torment struggling with these problems, and apparently making no progress. I felt almost like a juggler who, with half a dozen ideas for balls, was juggling them in that ceaseless, endless cycle, just depending upon which ideas were in the air, and those that were in my mind.

During the twelve years I worked in the Dewey School my task was to spend a week teaching wire bending, and, incidentally, the construction of Jackson appliances as the practical exercise attendant to the main idea.

On one occasion in Kansas City Dr. Dewey entrusted me with his class, apartment, dog, and everything but his Stutz and violin, while he went away to attend a meeting of the American Society of Orthodontists. He suggested that I could occupy my spare time by writing an article which should be finished and ready to send to St. Louis for publication upon his return.

Under this impressional mood, and inspired by the change from my own environment, I tried to think of something to write about. Finally, in desperation, I went back to the starting point of everything—appliances. Orthodontia

seemed to be nothing but appliances. It did not make any difference what the age or condition of the patient was, when he came into the office, work was started with the idea that if you worked twice as much, you would accomplish your work in half the time! It was a case of a patient, a dentist, a kit of instruments and presto! straight teeth, or what have you!

So the thought came to me that appliances were not going to stand still. Orthodontia as a science had gone too far. Great progress had already been recorded, and principles were rapidly evolving. Orthodontia had become the baby specialty of the healing art and was destined to attract the interest of many intelligent men; so it could not help but progress.

The article I finally wrote for Dr. Dewey was entitled "The Evolution of Principles of Appliances." It was a prediction that in the channels of evolution, progress would be marked by the recognition of the best principles of all the appliances, and that basically they would embrace the stability of a fixed anchorage and the more stimulating influences of a spring as the medium of pressure.

Time continued to roll by with some of the changes previously mentioned in the Angle appliances, all of which were accountable with different scientific incidents which were transpiring at the time, and the specialty was absorbed in these highly technical instruments.

I became disassociated from orthodontia for four years on account of entering the army; I not only was disassociated but was otherwise too much absorbed to keep up with changes which occurred.

The work of Dr. John V. Mershon, as an intellectual advancement, did not come to my attention in detail until it had been completely presented by him in practically the form, with only refining modifications, as it exists today. Never in my professional career has anything heartened me so much and brought me more satisfaction. There it was—my dream come true. With that appliance there was practically reconciled all of the irreconcilable things of every appliance I had known of, retaining and combining their better features. Fancy a fixed appliance so locked that it could be removed for the adjustment of delicate springs! Imagine an appliance whose size and form for anchorage hygiene, location and compactness meant flexibility and freedom from dangers in causing many troubles in the relief of others! The real beauty of this appliance struck me not as a mechanical device per se (as Dr. Foster used to say), but the fact that it was a mechanical expression of a background of thought which was founded in the very depths of living things. How we had all been punishing those delicate divisible parts of living tissue! What little attention had we paid to growth! To think of the cell so beautifully formed with all its powers of assimilation, disassimilation, growth, reproduction, stimulation, and many things which we do not know about at present. We were subjecting it to a battery and a punishment which produced such irritations and trauma as to defeat and destroy the very objects we were striving to attain.

I am not assaying here to champion lingual and labial arches with auxiliary springs over other appliances existing today, but as a matter of basic and fundamental principle, the knowledge amassed to date which must precede

appliances points directly to flexibility and comparative simplicity, appliances which bone can grow into or away from as directed but not forced along with them as at their command.

We can all know the laws and nature of growth. We can appreciate all of the processes which go with the growth of the face from birth to adulthood. We should know by now when we have a right to interfere and how. In every phase of the healing art, diagnosis must be backed by general knowledge and treatment should be accorded. I am firm in my belief that the most priceless jewel which every doctor possesses is his opinion, which he should carry in his heart. His very greatest responsibility is to his fellow man whom he may have the privilege to serve.

I believe that an orthodontic appliance is just as much a prescribed measure as the internist's medicine or the surgeon's knife. All three relate to therapy. I believe our basic theme should be to do the least we can, to be sure that we are doing the right thing at the right time. This means that some patients should be treated between three and one-half and six years of age, that others should be treated between seven and nine years, and others from the early teens up to full growth, or after. But it certainly does not mean that all patients should be treated at all ages and any time they happen to come.

What of the mouths you have seen which had been under constant treatment for seven or eight years? Growth in normal directions may have been retarded and local damage caused, much more serious than the original condition which was to be corrected. What a tragedy! We cannot possibly always foresee the time when a child is entering an accelerated growth period; and frequently as a prescribed measure, the appliances of the correct sort should be in position to guide and direct growth when it ensues; nevertheless I have treated cases over long periods with discouraging results, when during the next few months the very thing I had been wishing for so long has happened.

If I could have foreseen that exact period, probably most of that treatment would not have been necessary.

There are a great many cases which respond so beautifully to treatment that they seem to have the very will to meet every suggestion. There are other similar cases which may defy all efforts to the end of a modified result or failure. In both instances we may be dealing with conditions we think we are familiar with, and still either result may occur.

The science of orthodontia is still too much in the realm of empiricism and is not sufficiently grounded within itself that we can look into the hidden depths of each individual case and apply the varied formula accordingly.

It was because of these changes that I felt proud of the opportunity, upon leaving the army, to return to the practice of the constructive specialty I had loved so well. During the nearly four years' absence in the army, I saw a great many men trying to see how hard they could make things for themselves. In treating wounds through the face, doctors would endeavor to see how complicated they could make apparatus, generally accounting for their failure, but I never saw an incident where the virtue of well grounded simplicity did not only bring a result, but also brought a happy reward to the wounded soldier.

If, then, our theme is to be so skilled as to do the least we can at the proper time, why should it not be done as simply as would be reasonable to assume? If that is true, then light, clean, compact and thoroughly flexible appliances would seem to be the ones to which nature should best respond.

Dr. Mershon aptly states that it is the vital processes which cause teeth to change their positions, and not the appliances. As true as this statement is, let us make our appliances to fit the condition.

Progress in any science takes care of itself, for the proof of science is the survival of the truth.

The presence or absence of an orthodontic appliance in a mouth is the ultimate expression of our knowledge, and the result proves the accuracy of our judgment.

We are far from our goal, but the highway is open and progress is steady.

After these thirty years may I suggest that we should look our problems squarely in the face and not be misdirected down the byways of delusion, through which tradition or conjured influence we may be so easily led astray.

The science and practice of orthodontia is going on its way whether any individual likes it or not. It is going to serve the community differently and better than it is now for many reasons. One reason is the rational trend of appliances.

THE STEREOROENTGENOGRAM*

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THE dental literature on the subject of stereoscopic radiography is limited to only a few articles dealing with, in the majority of instances, the technic of making stereoscopic roentgenograms. An exceptional article by C. A. LeMaster, in 1924, presented a good practical technic for both intraoral and extraoral stereoroentgenograms.

Dr. Edmund C. Kells produced the first dental stereoroentgenogram in 1903, and at that time laid this new art in dentistry before the members of the National Dental Association. However, the profession was slow to take it up, and nothing on this subject again appeared until another article by Dr. Kells was published in 1912. In this article he again tried to stimulate the interest of the profession in stereoscopic radiography, and described the technic of making stereographs. Since then only a few articles have appeared.

The general apathy of the dental profession relative to the use of the stereoroentgenogram is probably due to the imagined difficulties of technic. The technic, however, is comparatively simple; and, when followed with a reasonable amount of care and accuracy, a reliable stereoscopic x-ray picture may be made with ease in little more time than is required to make a simple roentgenogram. Commercial enterprise has heightened interest in this field in the past four or five years, but relatively few dentists make use of this valuable diagnostic aid in their practice.

The stereoroentgenogram differs from the simple roentgenogram in that the simple x-ray picture is a record of superimposed flat shadows, while in the stereoroentgenogram the shadows are placed in their respective planes, and we have the sensation of perspective or depth. In binocular perspective, the retinal images, particularly of near objects, are slightly different in the two eyes. The right eye sees more of the right side of the object and the left eye sees more of the left side of the object. Therefore, in making a stereoscopic picture or roentgenogram it is necessary to produce one view which corresponds to the image that falls on the right eye and one that corresponds to the image that falls on the left eye. When these views are placed in the stereoscope, the right-eyed picture is thrown on the right eye and the left-eyed picture on the left eye, and the sensation of depth or solidity is apparent.

The technic may be divided into three steps: (1) preparatory procedure, (2) exposure of films, (3) developing and mounting for viewing.

1. Before the actual making of the stereoroentgenogram it is necessary to prepare the films so that the exposure which will correspond to the left-eyed picture may be differentiated from the right-eyed picture throughout the devel-

*Presented to the American Board of Orthodontia.

oping and mounting procedure. To mark the left-eyed exposure a small letter "L" is made from a piece of brass ligature wire and fixed on the emulsion side of the film by means of adhesive tape, so that the letter appears backwards in the lower right-hand corner, as shown in Fig. 1.

(You will note that Fig. 1 represents a number two Eastman x-ray film, and for purposes of description the technic of making a stereoroentgenogram of the maxillary incisor area will be followed.)

The letter "L" is placed in the lower right-hand corner because the finished x-ray picture will be viewed from the glazed side and when viewed from the glazed side the shadow of the letter "L" on the x-ray film will then be in the lower left-hand corner and will be reversed and in its natural position. The right-eyed film will need no marking.

For future aid in mounting, two wires about one-eighth of an inch long should be fixed to the patient's teeth by means of adhesive tape and parallel to

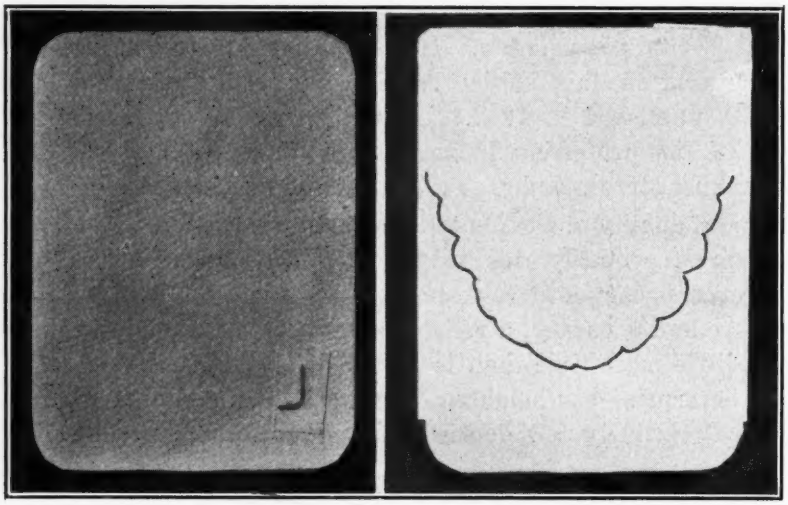

Fig. 1. Fig. 2.

the long axis of each tooth. These wires should be placed at widely separated points, the canines being preferable. In the event that fillings are present in these teeth or an orthodontic appliance is in the mouth, it is not necessary to place the little wires.

Now place the film marked "L" in a small manila envelope and place it in the mouth between the occlusal and incisal surfaces of the teeth and ask the patient to bite with enough force to hold the film in position. With a sharp pencil mark the outline of the maxillary teeth on the envelope from first molar to first molar, as shown in Fig. 2.

This will act as a guide in placing the second film in the same position in the mouth which will be a great aid in mounting and will eliminate eye-strain in viewing the finished stereoroentgenogram.

It is absolutely essential that the two films be placed in exactly the same plane to produce a stereoscopic x-ray picture, although they may be in any position in that plane. To assure the operator that this may be accomplished the patient must be instructed that two exposures are to be made and that the

head must not move between exposures. The patient's mouth should be opened by simply permitting the mandible to drop. Tipping of the head may be prevented by tying the patient's head to the head rest.

2. The x-ray tube is now placed in position and centered as if for making a simple roentgenogram. Now move the tube to your left, when standing in front of the patient, a distance of 1 9/32 in., place the envelope containing the film marked "L" in the mouth and make the first exposure. Remove the envelope and film, remove the exposed film and place a new one in the envelope and replace in the patient's mouth according to the outline on the envelope. Now move the tube 2 9/16 in. to the right and make the second exposure. The time of the second exposure should be the same length as the first, and the milliamperage should be the same. The distance of 2 9/16 in. through which the tube moved between exposures corresponds to the average pupillary distance of the average individual.

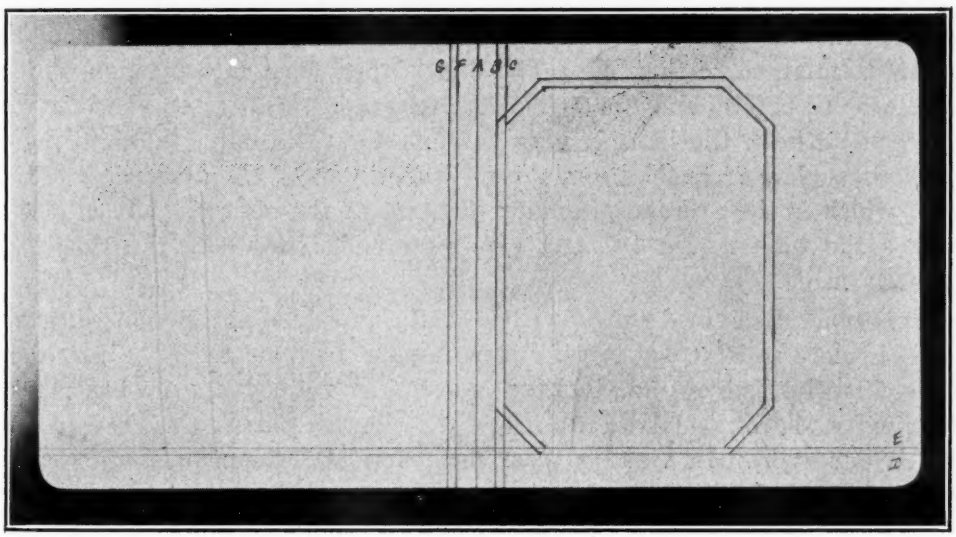

Fig. 3.

3. The films are now ready to be developed and should be developed for five minutes at 65 degrees F. It is advisable to place a film from both the left and right-eyed packet on the same developing rack to insure the same quality in both x-ray pictures.

After drying they should be mounted on a cardboard mount $7 \times 3\frac{1}{2}$ in. in the following manner:

A line three and one-half inches from each end is drawn on the side which will be the back of the mount (*A*, Fig. 3). On each side of this line, two more lines are drawn, the first one (*B*) 5/32 in. from the middle line, and the second one (*C*) 7/32 in. from the middle line. Two lines (*D* and *E*) are are then drawn, parallel with the bottom of the mount, one 4/16 in. from the bottom, the other 5/16 in. from the bottom.

The film marked "L" is placed on the right-hand side with the glazed surface on the cardboard. The bottom of the film must be on line *D* and the left side on line *C*. The outline of the film is then marked. The film is removed, and a line is drawn 1/16 in. inside of the entire outline of the film. Then,

with a sharp knife, a section of cardboard is cut out, making the cut follow the inside outline. This produces a window which is 1/16 in. smaller in every dimension than the film, and leaves a margin to support it. The film is replaced and fixed with strips of adhesive tape.

A window is now cut for the right film but smaller than the finished one will be, so that the position of the film may be ascertained by viewing in the stereoscope. The right side and bottom cuts are made on lines *G* and *E*.

The mount is then placed in the stereoscope, and the right film is held over the smaller window. It is viewed in the stereoscope and moved until there is a fusion of the two films into one image. The little pieces of wire fastened to the teeth when the x-ray picture was made are valuable aids in mounting the stereoroentgenogram. Where the images of the wires have fused until they show distinctly and clearly, there should be no eyestrain in viewing the stereoroentgenogram.

The film is held in position and removed from the stereoscope, and the outline of the film is drawn. A line is drawn 1/16 in. inside the outline and the window is enlarged to this line. The film is then fixed into position with adhesive tape as before, and the stereoroentgenogram is ready for viewing. This gives a dark field, the light coming through the films only, thus cutting out the blinding glare from the illuminator. The centers of the films are 2 9/16 in. apart, which is the average pupillary distance of the observer. It is also the distance the tube moved between exposures and reproduces the shadows as originally made.

It is generally agreed among writers on the subject of stereoroentgenography that it is more satisfactory to view stereoroentgenograms from the glazed side of the films instead of the emulsion side. This method of viewing gives us the "lingual aspect," and we are inside the mouth looking out. The patient's right is our right. In viewing from the "lingual," the main bone structure seen is that of the lingual plate influenced somewhat by the labial plate of bone, but not altering, to any marked degree, the appearance of the bone structure of the lingual plate.

Binocular vision or vision with two eyes differs from monocular vision chiefly in the varied combinations of movements of the two eyeballs and the aid thereby afforded in the determination of distance and size, in the enlarged field of vision, and, above all, in the more exact perception of solidity or perspective, especially for near objects.

When the two eyes are fixed on a given point, let us say in front of us in the median plane, each eye has its own visual field. The two fields overlap in a portion of their extent thus forming the binocular field. Every point in the binocular field forms an image on the two retinas. Some of the objects contained in the binocular field are seen single in spite of the fact that there are two retinal images while others are seen or may be seen double if one's attention is directed to the fact. Whether any given object is seen single or double depends upon whether its image does or does not fall upon corresponding points on the two retinas. If the object is seen single the image falls upon corresponding points of the retinas and if seen double, on noncorresponding points.

Visual sensations, upon which our conception of solidity is based, are of several different kinds partly monocular and partly binocular. For example, if we close one eye and attempt to thread a needle or light a cigarette or to do any coordinated movement that depends upon an exact judgment of the distance of the object away from us, it will be found that the resulting movement is far less perfectly performed than when two eyes are used.

The monocular sensation elements upon which we base our judgments of depth or perspective are aerial perspective, mathematical perspective, muscle sense and the disposition of lights and shades and the size of familiar objects. The influence of aerial perspective is noticed when an object is suddenly seen in a fog. It looms large and, due to the fact that we feel that a hazy object is at a great distance, this leads us to give a proportional overvaluation to the relatively large visual image made by the near object. The element of mathematical perspective is produced by the foreshortening of lines indicating depth, and muscle sense is produced during focal adjustment as we look first at objects in the foreground and then at those in the background.

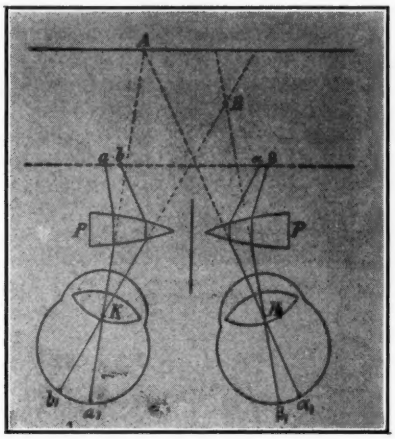

Fig. 4.—Diagram to illustrate the principle of the Brewster stereoscope *(Landois)*: P and P', the prisms, *a*, *b*, and *α*, *β*, the left- and right-eyed pictures, respectively, b, *β*, being a point in the foreground and *a*, *α*, a point in the background. The eyes are converged and focused separately for each point as in viewing naturally an object of three dimensions. (After Howell.)

Binocular perspective influences our judgments of solidity due to the fact that the retinal images are slightly different in the two eyes. "Our perception of solidity or relief is a secondary psychical act, and, as far as the binocular element is concerned, it is based upon the fact that the images are slightly different on the two retinas; but why this dissimilarity should produce an influence of this kind is not entirely understood. Certain facts have been pointed out as having a probable bearing upon the mental process. In the first place, in stereoscopic pictures, as in nature, we do not see the whole field at once. To see the objects in the foreground the eyeballs must be converged by the eye muscles so that the lines of sight may meet in the object regarded. When attention is paid to objects in the background less convergence is necessary." (Fig. 4.) "The point of fixation for the lines of sight are kept moving to and fro, and the sensation of this muscular movement possibly plays an important part in giving us the idea of depth or solidity. For persons not

practiced in the matter of observing stereoscopic pictures the full idea of relief comes out only after this muscular activity has been called upon. But for the practiced eye this play of the muscles is not absolutely necessary. The stereoscopic picture stands out in relief even when illuminated momentarily by the light of an electric spark. The perception of solidity in this case is instantaneous.''

In the interpretation of a stereoroentgenogram optical deceptions may occasionally enter to influence the interpretation. Wrong judgments regarding dis-

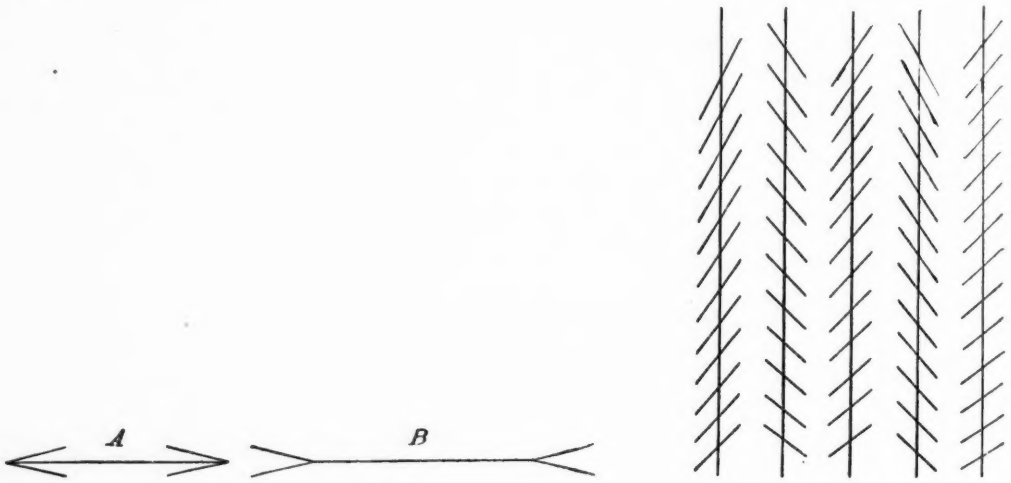

Fig. 5.—(1) Müller-Lyer figures to show illusion in space perception. The lines *A* and *B* are of the same length.
(2) Zöllner's lines. The vertical lines are parallel. (After Howell.)

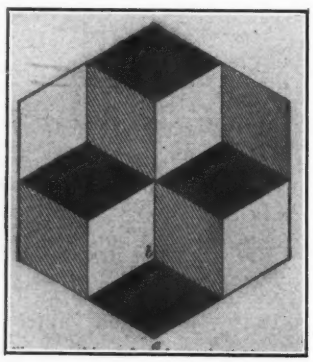

Fig. 6.—Figure to illustrate binocular deceptions depending upon different interpretations of the mathematical perspective and the lights and shades. On gazing fixedly the image will change from a single cube with black top resting on two others with black tops, to one of two cubes with black bottoms resting upon a single cube with black bottom. Still other figures may appear from time to time. (After Howell.)

tance and size are sometimes made. There is a tendency to undervalue the acute angles and to overvalue those that are obtuse (Fig. 5).

Binocular deceptions depending upon different interpretations of the mathematical perspective and the lights and shades must be considered. (Fig. 6.) However, with these things in mind an accurate interpretation may be made, and thus interpreted the stereoroentgenogram becomes a valuable diagnostic aid.

The advantage of the stereoroentgenogram lies entirely in adding one new factor of interpretation—depth. This is very important to the oral surgeon and the orthodontist because the positions of the different roots and their relations to one another and the position of unerupted or impacted teeth may be accurately determined. To the orthodontist it is exceptionally valuable for it enables him to move roots of teeth when necessary with a degree of confidence impossible to attain when evidence has been gained only by clinical examination and a simple roentgenogram.

CONCLUSIONS

1. The technic of making a stereoroentgenogram is comparatively simple, and good results will reward the operator who adheres accurately to the following: (a) both films must be in the same plane; (b) shift the x-ray tube 2 9/16 in. between exposures; (c) mount the two films 2 9/16 in. from center to center.
2. Our perception of solidity is a secondary psychical act.
3. Optical deceptions must be guarded against in interpretation.
4. The advantage of the stereoroentgenogram lies entirely in adding one new factor of interpretation—depth.

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ACUTE PYOGENIC INFECTIONS OF ORAL CAVITY

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ACUTE infections in the mouth may be classified as deep and superficial. In the superficial type of infection the lesions appear on the surface epithelium, such as Vincent's stomatitis. The deep infections are the acute abscess, osteomyelitis, and cellulitis.

The treatment of these conditions should be general as well as local. The general treatment is practically universal for all infections, i. e., proper elimination, adequate fluids, nourishing and easily digestible foods, supplying the required vitamins, and sunlight or its equivalent in synthetic light rays. The local treatment depends upon the individual case. One thing we should always keep in mind in the treatment of all disease is to assist nature and not work against her.

It is unfortunate that patients with acute infections of the oral cavity and face cannot be immediately hospitalized where adequate routine examination and treatment can be instituted. Urinalysis, blood counts, bacterial cultures, temperature and respiration charts, etc., are extremely useful in the management of these cases, and many of the fatalities occurring from such lesions can be avoided. It is true that but few fatalities result from simple acute infections of the oral cavity; nevertheless, we must guard against these few. It may be a matter upon which the patient's life depends, and it is our duty to give him every possible chance.

ACUTE PERIAPICAL ABSCESS

Acute periapical disease is an inflammatory reaction in the tissues immediately surrounding the apex of a tooth root; it has a rapid onset and is attended with symptoms of acute inflammation, such as redness, swelling, heat, and pain, which are sequelae of the death of the pulp.

An acute periapical abscess may be primary or secondary. It is primary when it immediately follows infection of the peridental membrane by passage of bacteria from the pulp canals through the apical foramen. It is secondary when it occurs as a flare-up in a case of long standing chronic periapical disease.

The first reaction after the infection escapes through the apical foramen of the tooth is an inflammation of the pericemental membrane. The tooth has an "itchy" sensation which is relieved by pressure or by the stress of mastication. The pericemental membrane becomes engorged with blood, which thus thickens it and forces the tooth partially out of the socket, so that it is slightly higher than the approximating teeth. Occlusion is then extremely painful. The inflammation may become localized or may spread throughout the whole membrane. Often other teeth are involved. If the inflammation is not aborted, there is a

localization of pus and abscess formation. Edema usually accompanies an alveolar abscess, often involving the lips, cheek, and inferior orbital tissues. There is usually a discoloration of the tissues.

In the diagnosis of acute periapical abscess, it is important to determine the tooth or teeth causing the abscess. Often this is rather misleading. The adjacent teeth may be loosened in their sockets and as many as five or six teeth involved, all of which may appear suspicious. Roentgenograms may not be of much help if the abscess is primary, because the x-ray picture shows not the infection itself but the result of infection, and there may be no bone destruction at this time.

Cold applications are indicated where there is inflammation, to prevent swelling. After congestion, heat in the form of a saturated solution of magnesium sulphate applied by sponges to the outside of the face, or light treatment, is advantageous and aids abscess formation. The treatment of acute periapical abscess is not unlike the treatment of other abscesses, i. e., incision and drainage. Sometimes the abscessed cavity can be drained through the root canal by opening into the pulp chamber of the tooth. If the infection has broken through the bone and is subperiosteal, the periosteum should be elevated and a drainage tube inserted. If definite fluctuation is felt in the buccal fold, incision is then made directly into the abscessed cavity, and a drainage tube is carried to the full depth of the cavity. Sometimes the infection breaks through the bone above the attachment of the buccinator muscle. In these cases, the pointing is generally toward the outside of the face and must be opened externally. Infection follows the lines of least resistance. Acute abscesses, with maxillary teeth as the focus, sometimes drain into the maxillary sinus causing an empyema of that sinus. Transillumination will generally show up this condition, but, in cases where there is considerable swelling in the infraorbital region, the shadows are sometimes misleading. Stereoscopic roentgenograms of the head will usually confirm the diagnosis. Occasionally, we see alveolar abscesses that drain into the nasal fossa.

It is usually better to defer the removal of the tooth causing the trouble until after the acute condition subsides. The curettement of bone is contraindicated in all acute conditions because it usually carries the infection deeper into the bone and may lead to osteomyelitis.

Acute periapical abscess generally runs its course in two or three days unless untreated. From the untreated cases, several serious complications may result.

When acute periapical infection does not localize to become chronic, one of two sequelae results; either the infection becomes diffuse, spreading through the periapical bone causing a bone marrow infection or osteomyelitis; or it pierces the cortical bone, spreading through the soft tissue to become a cellulitis.

LUDWIG'S ANGINA

Ludwig's angina is a phlegmonous inflammation of the floor of the mouth and upper part of the neck characterized by a spreading infiltration of the soft tissues. The infection, travelling by way of the cellular planes, is too rapid to

become localized and often overshadows lymphatic involvement. It is a streptococcus infection occurring usually secondary to some other disease.

It frequently follows a chronic swelling, the result of an acute periapical abscess, which, having remained dormant for several days or weeks, suddenly becomes active; or it may start in a submaxillary lymph node. Thomas, in his report of some 106 cases, states that insignificant lesions in the mouth, such as infected teeth, tonsillitis, etc., are usually the primary foci leading to a lymphatic involvement. Infections of the submaxillary gland, caused by calculi in the submaxillary duct that break through the capsule, also may act as a primary focus.

The symptoms of Ludwig's angina are obvious. The induration in the floor of the mouth is boardlike in consistency, spreading between the inferior borders of the mandible. It may appear to be attached to the bone on one or both sides. The skin covering the area is somewhat blanched and immovable, and is not flexible to pressure. If the swelling is above the mylohyoid muscle, the tissue may roll above the mandibular teeth. The tongue is pushed upwards and backward into the pharynx, and there is usually some respiratory impediment. In the advanced cases, edema of the glottis, of which George Washington died, is not an infrequent complication. The constitutional disturbances are similar to other toxic infections. Septic pneumonia is a frequent complication, and the latent cases often develop into a general septicemia.

These infections are not to be trifled with and must be handled immediately and correctly. If the induration is above the mylohyoid muscle, the incision may be made under the tongue and a tube drain fixed by means of adhesive strips to the lips, as illustrated by Mead. If the bulk of the induration is below the mylohyoid muscle, as is most often the case, external incision must be made and made sufficient to permit the escape of all exudate from the floor of the mouth and parts of the neck indurated. The incision should be in three directions: from the tip of the chin opposite the symphysis to the hyoid bone; then a horizontal incision is carried laterally on each side, parallel with the inferior border of the mandible. This allows generous flaps to be turned back and allows the ready escape of toxins, thus establishing drainage, which will help nature to build up a defense against the rapidly spreading infection. Fox advocates, together with this method, the administration of potassium iodide.

The prognosis is always questionable. The mortality rate has been estimated at over 40 per cent. Early diagnosis and treatment point to a favorable outcome of this disease. Blair states that death in from seven to twenty days is a frequent sequel in untreated cases.

OSTEOMYELITIS

Osteomyelitis is a suppurative inflammation of bone marrow.

Mead, who has done considerable work on osteomyelitis of the jaws, states that the disease is due to the presence of one or all of the following: staphylococcus, streptococcus, pneumococcus, or *Bacillus coli communis*. Osteomyelitis may be hematogenous in origin, or it may be caused by infection from the teeth or their surrounding structures. Dental caries is most frequently the causative factor.

This infection may result from the extraction of teeth involved with acute symptoms of pain, swelling, and pus, where adequate drainage has not been established and maintained. It is frequently associated with maxillary sinusitis. It is seen accompanying traumatic bone injury, such as fractures. It may occur as a complication to acute periapical abscess. The usual signs of inflammation are present in osteomyelitis. There is deep-seated pain and tenderness due to the pressure exerted within the bone. In the acute stages, the tissues over the area are usually greatly swollen. Trismus of the muscles of mastication is always present. There may be painful deglutition. General symptoms are fever and prostration; the symptoms are more marked than those of acute periapical disease. Blair states that grave septicemia, and even pyemia, with metastatic abscesses of other parts of the body, are often a result. The infection may involve the whole bone or may remain unilateral. Eventually the pus burrows through the cortical bone to the soft tissue and evacuates into the mouth or externally to leave a sinus which persists in draining. The lymphatics of the submental and submaxillary region become involved and can be readily palpated.

Incision is indicated wherever fluctuation is felt. Incision and drainage plus watchful waiting are the recognized treatment. Curettement is contraindicated. Sequestrum formation eventually takes place. It is essential not to attempt the removal of any sequestrum until separation occurs. To do so surely invites further complication because the osteogenic cells, which are at work laying down new bone, may be destroyed. This would only prolong the disease. It is better to postpone removal of sequestrum a month or more than to attempt its removal before it is completely denuded. There may be several sequestra, and several subsequent operations may be indicated for their removal at different times. The individual case governs the treatment. Pain can be lessened by the application of an ice bag over the affected part, but sedatives will usually have to be administered.

A great amount of bone is sometimes lost through this infection. Pathologic fracture is often associated with osteomyelitis of the mandible. It is one of the most stubborn conditions, with which we have to deal, in its response to treatment.

PERICORONAL INFECTIONS

Pericoronal disease is an acute inflammatory infection starting in the tissues immediately surrounding partially erupted teeth, especially mandibular third molars, usually ending in abscess formation and suppuration.

The causes of these conditions are many. Partially erupted third molars usually give rise to pocket formations, which afford excellent harbors for bacteria. Food is easily collected in these pockets. The action of the bacteria always present causes putrefaction, leading to severe infection. Opposing maxillary third molars, constantly pounding the tissues over the partially erupted mandibular third molars, cause an inflammation and a lowering of local resistance, which predispose to infections of this type.

This condition is a definite clinical entity. As these infections appear in the mandibular third molar region in about 95 per cent of the cases, we shall

consider particularly the symptoms from that source at this time. There is always a trismus of the muscles of mastication due to a secondary inflammation of the masseter and internal pterygoid muscles; hence, the inability to open the mouth is obvious. There is usually painful deglutition. The lymph nodes in the digastric triangle invariably may be palpated.

The diagnosis is easily made by one who frequently handles these cases, but they have been mistaken by the general practitioners of both medicine and dentistry for tuberculosis of the jaws, lues, and malignancy. A history of the onset, as to duration of time, will usually differentiate it from other lesions.

The treatment should be, during the acute stage, hot irrigations by means of an irrigation bag every fifteen minutes or half hour until the muscles are released from tension. Local application of argyrol or metaphen is helpful. Sometimes, after the condition subsides, the tissues over the partially erupted third molar can be removed with actual cautery; thus, eliminating the pocket formation from whence the infection starts. This procedure is advisable only when there is adequate space posterior to the third molar. In patients with short jaws, this treatment is not indicated, and the partially erupted molar will have to be removed. It is unfortunate that these mandibular molars cannot be retained because their removal usually causes a looseness of the contact points between the second and first molars, and the second premolar, which predisposes to peridental disease. These teeth should not be removed during the acute stage of infection. Blum reports a case of cavernous sinus thrombosis through attempted removal of a partially erupted third molar involved in acute pericoronal infection.

It is sometimes advisable to remove the maxillary third molar in the early stages of the infection, especially where it is causing an irritation, since this extraction often immediately relieves the symptoms.

These cases readily respond to treatment and usually clear up in from three to five days.

CAVERNOUS SINUS THROMBOSIS

Since cavernous sinus thrombosis has been known to follow oral infection with a mortality rate of 100 per cent, it may be appropriate to include it at this time. Thrombosis of the cavernous sinus is a plugging of that venus blood sinus at the base of the brain. It generally follows acute infections of the mouth, face, or orbit, and is septic in origin. In a study of thrombosis in man, Lubarsch was able to exclude an infectious agent in only thirteen per cent of the cases. Schaefer reports on six cases of cavernous sinus thrombosis following surgical intervention of acute infections in the mouth and lip.

Infection travels to the cavernous sinus by way of the angular and ophthalmic veins. Both superior and inferior ophthalmic veins pass through the superior orbital fissure, to open into the cavernous sinus, either separately or by a common trunk. The superior ophthalmic vein is the larger of the two. It takes its origin at the root of the nose where it communicates with the angular vein. The inferior ophthalmic vein is brought into communication with the pterygoid venus plexus by an offset, which passes through the inferior orbital fissure.

These veins do not have any valves, so that infection has an easy course to the cavernous sinus.

Lesions of the upper lip, such as furuncles, abscesses, infected hair follicles, etc., should be cautiously approached and surgical intervention in practically all instances is contraindicated.

CONCLUSION

An attempt has been made in this paper to bring out some of the more serious complications that may develop from oral infection, together with a brief outline of their treatment. Time and space do not permit the detailed description of anatomy, bacteriology, pathology and surgical technic. These subjects will be considered in subsequent papers, together with superficial pyogenic infections.

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DEPARTMENT OF
DENTISTRY FOR CHILDREN

WHAT ABOUT DENTAL HEALTH INSURANCE?*

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DEFINITION.—"Health, or sickness insurance is essentially a method of distributing the burden of sickness among the lower-paid classes of the population." (Simons-Sinai.[1])

Whenever an industrial depression appears in this country, a tremendous amount of legislation of all sorts deluges the country to try to relieve the financial distress. Medical care ranks sixth among America's leading industries, being exceeded only by agriculture, construction, railroads, textiles, and machinery. "The people of the United States pay more for medical care than they do for iron and steel, oil, coal, clothing or meat. . . . Judged in terms of the nation's total medical bill the care of the teeth takes the highest toll—20.4 per cent of all the charges put together—with an average expense of $18.59 per case." (Clark.[2])

The Committee on the Cost of Medical Care[3] estimated that of each $100.00 collected by the doctor $40.00 is paid out in overhead. They also found that "at least one-third of the doctors of the nation are underpaid in terms of the cost of maintaining a minimum standard of decent living. Some 40,000 physicians received less than $2,500 net in 1929. Undoubtedly the same group received much less as the depression deepened. As many as 22,000, or 18 per cent received less than $1,500 in 1929."

The Chicago Council of Social Agencies gave as a minimum budget for a "self-supporting family," the total of $1,548.84. With rent this would amount to around $1,700.

The National Bureau of Economic Research gave the percentage receiving less than $1,700, which was the figure given for a minimum of health and comfort, as 81.99 per cent of the population. Or to be more specific 70 per cent of the nation lives on a budget of $1,200 or less a year.

So when a depression appears, people look for panaceas to meet the situation. A search of history reveals that the Egyptians insured their slaves and the Greeks had certain forms of insurance. For lack of time historical references will be left out, only to say that, "One of the most clearly established laws of the relation of economic conditions to social legislation is that every period of industrial depression greatly increases the amount of such legisla-

*Read before the Orange County Dental Society, May 3, 1933.

tion. The causal connection should be clear. In the United States the deep and prolonged depression of 1873 and following years was accompanied by the rise of the Greenback Party, 'Granger' legislation, and the establishment of state railroad commissions. The Interstate Commerce Act of 1887 followed the depression of 1885. The collapse of business in 1893 was succeeded by the Pullman strike, populism, free silver, and much social legislation. The panic of 1907 gave rise to the Progressive Party, conservation, and much 'welfare' legislation, including workman's compensation. The next depression came in 1914 and was followed by the World War with its phenomenal extension of government powers and activities, one expression of which in 'reconstruction' years was the health-insurance movement just described.''

The multitude of ideas tossed upon the public in the last few months shows how the wind is blowing.

SOCIAL SERVICE FINANCIAL RATING CLASSIFICATION

Let us study the individual and if possible classify him according to his financial needs. We shall eliminate the rich and middle classes from this discussion.

1. The financial condition is such that the patient is definitely in the poverty class. This class of indigents must be cared for by public taxation or private philanthropy. For several years, in other papers, I have discussed the care of these people by the so-called ''free clinic'' or dispensary, and shall refer you to the literature on this subject.

2. In this grouping the patient is just above the poverty line, and any debt incurred would precipitate him below the poverty line. In this group I have always felt that the dispensary or public health center offered the best service. It is possible that some form of insurance could be developed for this group, but the odds seem to me to be against it for many reasons, such as ignorance, low wage earners, race, etc.

3. There is a group which requires long time of treatment, and there is no prospect of meeting the obligation. In this class appear orthopedic cases, tuberculosis cases, malignant diseases cases, etc.

These patients must receive help in tax supported institutions, Red Cross and anti-tuberculosis sanatoriums, or from a partial help plan. I have my doubts as to whether insurance could be successfully applied in these cases.

4. Then there is that class in which there has been a past illness in the family, in which a debt has been incurred, and further physical remedy, though sorely needed, is not attended to. Many of these are cared for at public expense in clinics, health centers, and private philanthropic institutions. It would seem to me that a partial payment or possibly an insurance plan for hospitalization could be applied in this class.

5. One large class of patients is represented in Southern California by such races as the Mexican peons, Japanese gardeners, Filipinos, etc. These patients come under the classification of people whose finances do not point toward relief, and whose mental capacities do not grasp the necessity of remedial measures. This last group of patients requires the most intense and

painstaking preventive work that the health worker can possibly give. In this class we have a tremendous health problem because of our nearness to the Mexican border and to a large shipping center like San Pedro Harbor. Epidemics of bubonic plague, leprosy, cholera, and many other diseases make their first appearance in this group.

I think you see by now that health insurance could only successfully apply to the low-wage earner and one who had been in this country long enough to have some rudiments of education.

ARGUMENTS IN FAVOR OF HEALTH INSURANCE

1. The state owes every individual health and proper living. This is probably the socialistic viewpoint.

2. The North American countries have had little experience with social insurance on European lines, and if they had they would be quick to realize the improvement in social conditions.

3. It is argued that existing agencies are inadequate, and consequently only a small number of the general population have the coverage of health insurance.

4. It is often urged that social insurance legislation would encourage mobility of labor by "destroying the spirit of servility and fear." The English experience has proved the opposite of this by tying labor to a locality and preventing migration.

5. It is argued that it removes the stigma of charity and builds up morale. The dole system in Europe proves the opposite.

6. Compulsory state insurance, it is argued, carries a lower overhead. But it costs more in political bureaucratic taxation in the end.

7. It is argued that the cost of medical care is excessive and that compulsory social insurance will lighten the load.

8. It is claimed that national health insurance reduces the demand for patent medicines.

9. Social insurance, particularly in Germany, is supposed to have increased the expectation of life. But Wolfenden claims this is merely a manipulation of actuarial tables, and any good student of insurance can answer this in the qualified negative.

10. A favorite argument is that compulsory sickness insurance increases industrial efficiency by reducing time loss from sickness. Sinai and Simons point out that "the fact is that the number of cases and days of incapacity shows a decided inclination to increase much beyond estimates."

11. It has been argued that there would be a direct saving to taxpayers in hospital and clinic maintenance. When this came up in California about 1918, the Commonwealth Club of California, after an examination of the question, expressed the opinion that compulsory health insurance, "will not, to any extent, relieve the public from maintaining clinics, hospitals, and other public charities for the sick poor." The California Constitutional Amendment was decisively defeated.

ARGUMENTS AGAINST SOCIAL INSURANCE

1. All forms of social insurance are largely incompatible with the spirit of individual freedom, responsibility, initiative which is so largely characteristic of North America.

2. All forms of social insurance to which the state directly contributes, either by regular payments or by intermittent grants-in-aid, inevitably involve the consequence in the last analysis, if not primarily, the assumption that the state is to be responsible for the ultimate financial sufficiency of the scheme.

3. Health insurance involves the gradual taking over by the state of individual responsibilities. The dole in England and in certain cities, as Detroit in this country, is an example of state assumption of responsibility. It is believed by some that the dole system in Detroit was the seed out of which the present banking situation arose.

4. Compulsory social insurance is a "left-handed taxation scheme," and as one man recently proclaimed before the Los Angeles County Dental Society, "it is of the devil."

5. Clay, Stamp, and many other economists, contend that the cost of the social services imposes a serious handicap in international competition.

6. Sir Arthur Newsholme says that the British health insurance scheme has "involved expenditures in administration entirely incommensurate with the benefits received."

7. State health insurance inevitably brings on serious competitive dislocation of existing charitable and commercial organizations.

8. Samuel Gompers, speaking for labor, said, "I am more concerned . . . with the fundamental principles of human liberty and refusal to surrender rights to governmental agencies than I am with social insurance." He contended further that high wages, better homes, clothing, food, and opportunities and shorter hours, will be more effectual in ameliorating the condition of the worker than social insurance projects.

9. Careful consideration must be given to any scheme before legislation is enacted because, "an unmistakable tendency has been evident to introduce legislation at the behest of politicians and social reformers; and frequently these classes neither desire nor are competent to appreciate either the cost or the technical actuarial and financial problems which must receive the most careful consideration well in advance if any such plan is to have a reasonable hope of financial solvency." (Wolfenden.[4])

10. Every state scheme has shown that the actual cost is always very considerably greater than that assumed at the outset. European experience "has demonstrated conclusively that the inauguration of one type of scheme leads to agitation for yet more—first old age pensions, then health insurance, then unemployment insurance, then contributory widows', orphans', and old age pensions, with continual pressure to relax restrictions, increase benefits, and reduce employees' contribution, until in Great Britain the burden has become so formidable that the cost of the social services is over twice that of the next country, namely, Germany, and six times that of France which follows, and unquestionably has contributed in large measure to the unsatisfac-

tory financial condition of the national exchequer which finally culminated in the drastic balancing of the budget and the abandonment of the gold standard in September, 1931."

11. F. L. Hoffman summarizes the principal objections to the medical system of the British Act as follows: (a) medical attendance has deteriorated by being standardized; (b) it is concerned largely with trivial complaints involving great waste of time; (c) medical diagnosis has become a casual routine; (d) home and night visits are discouraged and surgical operations are frequently delayed; (e) there is no really adequate provision for specialist treatment or for dental treatment; (f) the prescribing of drugs has been made a routine matter, resulting in a deterioration in pharmaceutical practice; (g) since the right to benefit depends upon a medical certificate of incapacity for work, there is a temptation to certain physicians to grant certificates without thorough and conscientious inquiry; (h) since panel doctors may also practice privately, the private patients frequently obtain separate preferential consideration; and (i) in general the influence of the medical profession, particularly in its relations with the government, has declined.

Now, considering the dental problem directly, I shall read the conclusions summarized by Simons and Sinai and then I shall enumerate some of the plans before the profession today.

"1. There is practically no important opposition to the principle of health insurance in any country where it now exists. There is criticism in plenty and constant effort to change details, but no agitation for the repeal of the system as a whole and no suggestion to return to the conditions of pre-insurance days.

"2. No health-insurance law has as yet been formulated primarily as a health measure, and it is doubtful if any are being administered with health care as the dominant purpose. All were enacted to meet the problem of poverty in time of sickness, and the treatment of disease has always been secondary to the relief of poverty.

"3. It is a question whether any of the systems called by that name are really insurance. The insured always receive more in benefits than they pay in contributions. The distribution of the combination of cash payments and professional services for a benefit so affected by psychological influences as sickness does not lend itself to actuarial reckoning or to the rules that prevail in other insurance fields.

"4. Every attempt to apply the principles of voluntary insurance on a large scale has proved to be only a longer or shorter bridge on the way to a compulsory system. Every so-called 'voluntary' system is successful in just about the proportion that it contains compulsory features, especially in selling and the collection of premiums. Such voluntary systems are of interest primarily because they set the pattern for the coming compulsory legislation. Many of the least desirable features of compulsory schemes were inherited from previous voluntary systems. This point is of paramount interest to nations still in the voluntary stage.

"5. There is practically no opposition in the medical professions of any insurance country to the principle of insurance. In spite of sharp criticisms

and violent denunciations of details, the national associations of physicians and dentists have, over and over, formally approved the provision of health care to the lower-income classes through insurance.

"6. Wherever dentistry was not included from the beginning in an insurance scheme, the demand for its extension to dentistry has come from dental associations. *No dental association in any insurance country has ever officially condemned the system of insurance.*

"7. There is practically unanimous agreement that the insured receive better medical care than they did before they were insured. The logical, although not necessarily wholly certain, conclusion is that those protected by insurance are better cared for than the corresponding economic class in non-insurance countries.

"8. There is wide variation in professional incomes under insurance; but they will average at least as high, and probably somewhat higher, than they were in private working-class practice before insurance. There is no loss by bad debts, and there is a much larger sum of money expended for the work of physicians and dentists. There is less idle professional time; the average insurance physician and dentist does considerable more work and receives somewhat more pay than he did before the installation of insurance.

"9. In every insurance system there has been a fairly steady increase in the number of persons sick and in the number of days of sickness per capita annually. The increase is most rapid among married women, next among unmarried women, and least among men. These trends are found in practically every insurance system, although they are generally much stronger in systems where the conflict between the societies and the medical professions is sharpest and lay control most exercised. In spite of inevitable inaccuracies and incomparable qualities in vital statistics, the tendency seems sufficiently well established to justify the conclusion that universal free medical service does not reduce the amount of recorded sickness.

"10. The introduction of health insurance, with its great extension of medical service, has never been shown to have had any appreciable effect upon the death rate. The rate of decline is approximately the same in insurance and non-insurance countries, where other conditions are comparable.

"11. While the statement might be disputed by insurance societies, a comparative study of many insurance systems seems to justify the conclusion that the evils of insurance decrease in proportion to the degree that responsibilities, with accompanying powers and duties, are intrusted to the medical professions. The important countries with the least internal conflicts and most general satisfaction are Denmark, France, Great Britain, and Sweden. These are also just the countries whose national medical associations gave an affirmative answer to the International Medical Association's question, 'Does the medical profession have an effective and efficient control in the organization of medical care in the home, hospitals, sanitaria, and other cures?' The logical conclusion would seem to be that control and responsibility in any insurance system should be given to the medical professions just as fast as they develop the necessary interest, social knowledge, and leadership to enable them to assume these functions.

"12. In countries where the medical professions have not prepared for and assumed a position of leadership in the new social and economic phases of health care, with corresponding responsibilities and duties, this professional indifference to public social health problems tends to be reflected in corresponding indifference, or even hostility, to the medical professions on the part of the public. One manifestation of this attitude is an increase in patronage of unqualified practitioners and proprietary cures. In insurance countries, absence of professional leadership is also accompanied by a focusing of interest in professional publication upon financial, rather than health, questions, whenever social health subjects are discussed. This leaves the initiative in the elaboration and administration of new developments in health care (which are basically social) in the hands of insurance societies, industrial managers, welfare workers, and other lay organizations. The inevitable result is continuous growth in lay control of professional work.

"13. The more completely the entire system of cash benefits is separated from medical service, the more successful and satisfactory are the workings of any insurance system. Cash benefits in time of sickness, like those for old age, widowhood, unemployment, military service, etc., should be based upon economic conditions or legal definition, in which health is but one factor. Health care and medical service can then be sufficiently differentiated from its necessary economic phases to make professional control possible and efficient.

"14. When the economic side dominates, as it does in most insurance systems today, the administration tends to become constantly more complicated and expensive. A multitude of records, mostly concerned with checking abuses arising out of the confusion of objectives and consequent internal conflicts, are required. Complicated and expensive accounting, checking, and actuarial systems are installed. Elaborate and costly machinery for controlling the cost of drugs, the character of the medical practice, the collection and distribution of contributions and benefits, the checking of malingering, the control of practitioners, and the adjustment of disputes between the various contending parties create complex bureaucracies that constitute veritable 'states within the states.'

"15. The greater the economic domination of any system of insurance, the more it tends to become a political football. Questions of medical treatment seldom become political issues. Wherever the administration of insurance is in the hands of societies, they exercise great political influence. This is one of the sources of the apparently irresistible pressure for bigger benefits for more and more of the population. Separate administration of medical service would relieve health insurance of much of this pressure and the accompanying political difficulties, since there is no such clamor for the extension of medical benefits as there is for cash.

"16. Diagnosis and treatment are apt to be imperfect and hasty under insurance, but there is practically unanimous agreement that these services are superior to those received by the same class as the insured in pre-insurance days. No system provides for any thorough examination at the time of en-

trance into insurance or on the occasion of the first visit, and the records that are kept are usually of no great medical value. This superficial treatment is not inherent in insurance. Some systems have already taken steps to improve insurance practice and to raise it above the level of the average private practice. The elimination of minor diseases, relieving the practitioner of 'police duty' for the societies, and better provisions for laboratory and hospital services might go far toward the attainment of such an ideal.

"17. Owing to the definite specific character of dental work, the dentist is subject to less difficulties than the physician under insurance. Questions of malingering, neuroses, and certificates of incapacity do not usually trouble him. There is considerable friction over the character and the cost of the work to be done, and little opportunity for preventive work. He is caught up in almost all of the difficulties concerning remuneration that come from being involved in a system concerning which he had little fore-knowledge of its coming and less to say about its provisions.

"18. Many of the problems of dental care for the low-income classes, and for much of the rest of the population, can at least be partially solved without insurance by an adequate system of care during the school age.

"19. Insurance is only one possible way of providing the necessary wider distribution in time and population of the cost of health care among the underpaid. The possible expansion and development of other, especially already tested, methods should be carefully considered; and, if insurance then seems desirable, it should not be permitted to dominate all other forms of service, but should be confined strictly to the purpose of meeting the cost of medical care for those who cannot meet that cost individually."

PLANS FOR MEDICAL AND DENTAL CARE

1. *Committee on the Cost of Medical Care Plan.* To understand this plan, the final report of the committee, known as, "Medical Care for the American People," should be read and studied. The majority report, in condensed form appeared in the January, 1933, issue of the *Journal of the American Dental Association,* also the Minority Report No. 2, which is the dental point of view.

2. *The Medical Guild Plan.* This is the Filene group known as the Twentieth Century Fund, Inc., and is put out in book form by Evans Clark in *How to Budget Health.* It is supplementary to the plan enunciated by the Committee on the Cost of Medical Care. The Mayo Clinic is an example of this group plan.

3. *The California Plan or Graves Plan.* The following plan appeared in the *Literary Digest,* November 26, 1932:

"California puts forth a claim that it has solved the problem of high cost of illness.

"A plan sponsored by the State Medical Association assures, so we are told, complete medical care and hospitalization to persons of moderate means.

"Differing from anything hitherto attempted, payment for illness will be handled through county medical societies, cooperating with local hospitals.

"The middleman's profit is cut out, together with the expense of maintaining separate insurance organizations so that service can be rendered for a nominal amount. Says Dr. G. P. Porter of the State Health Department, in a news release:

" 'The beneficiary would select his own physician from the membership of the county medical society. Every physician in good standing is eligible to membership. The medical care would cover all types of disease and injury.

" 'The patient also would select his own hospital from a list of those cooperating with the society. The hospital service would include laboratory, x-ray, drugs, dressings, operating room, and floor-nursing, and would cover all except contagious diseases.

" 'The plan originated with Dr. John H. Graves, president of the California Board of Public Health. He drew up the plan, and the State Council has endorsed it and is presenting it to the various county medical societies. Each society that undertakes it will fix its own rates, and designate the maximum income it regards as constituting "moderate means." Persons with larger incomes will not be eligible for the service.'

"In outlining the plan, Dr. Graves said:

" 'At the outset, all profits that would go to agencies, insurance companies, promoters, etc., are abolished. The medical profession will offer professional service to people whose income for the past year is below a certain fixed sum, for any and all types of disease and injury, where the individual is not protected under the Workmen's Compensation Act. The payments would be on a fixed annual, semiannual, or quarterly basis.

" 'Each county medical unit will operate as a partnership, and the division of moneys received will be on a unit basis—a fixed amount for each type of service. Such a plan definitely answers critics who claim that we are not interested in cooperative efforts of a social nature.

" 'To further assist persons of moderate means in meeting the expense of illness, separate and distinct from doctors' services, the partnership of the county medical society can promote a plan for hospitalization among the hospitals of their respective communities. The hospitals would form a cooperative organization offering to the public for an annual semiannual, or quarterly fee, accommodations and service for all non-contagious diseases, and all injuries where persons are not covered under the Workmen's Compensation Act, for periods of one, two, and three months' duration.

" 'Rates for children and dependents, and arrangements for obstetrical service are simple matters of detail, easily settled.

" 'Such a plan preserves inviolate the relation of physician and patient, and distributes the cost of illness as efficiently as any insurance system. It is claimed by those who have been interested in the problem that this is the first logical solution of the question of how to place in the hands of people of moderate circumstances an easy and practical method of securing all the advantages of modern scientific medicine and surgical aid for themselves and their dependents at a cost so reasonable that it can be secured without financial hardship.' "

4. *The Millberry Plan.* This plan is given in full in the *Pacific Dental Gazette,* January, 1933. The following is an excerpt from that plan:

"There are in reality two classes of people to deal with: (1) Those who are able to care for themselves and their dependents; and (2) those who have to be cared for.

"For patients of the first group provision should be made for good dental service at a price they can afford to pay. This implies that the family budget must be so apportioned that the sums for food, clothing, shelter, health, education and recreation are adjusted equitably and further implies that fees for dental service must conform to the incomes. The type of work prescribed should also be in keeping with the price which the patient can afford to pay.

"For patients of the second group, I believe a government service, supplemented by private philanthropy, is best. This service should be divided into a relief service for indigents and children, who would not otherwise receive it, and a part pay service for those who, through some form of contributory plan, could pay the costs. The latter group should be subjected to some form of an eligibility test and only admitted after careful investigation by qualified representatives of a social service organization, preferably a central unit maintained by the community. The cost of maintaining the service for the indigent group should be borne by the county or community as a part of its health program.

"For children the objective should be to maintain mouth health and to prevent dental disease, a program which is fabricated on three accepted basic principles—adequate diet, good home care, and early and frequent professional care.

"For adults, objectives should include first aid and the eradication of infection, which might result in hospitalization at community expense. I see no need of a community assuming responsibility for restoring or replacing teeth for persons who do not appreciate their value and have no interest in caring for them.

"The service should be rendered in public clinics where, except for the necessary privacy in cases involving surgery or extracting, or rebellious children, all persons who come would be seen by all others. Such openness has a strong tendency to deter non-indigent persons from making applications for service. If they are treated as private patients, they might unscrupulously take advantage of such a clinic for personal gain."

5. *The Alameda County Plan.* This is a cooperative plan between the county charities and the medical society.

"*Procedure for Handling Calls*

"*Unknown Cases*

"A. Home visits to patients whose financial status is unknown:

"I. *During hours when social agencies are open.*

When a request for a home visit is received, the following procedure is carried out:

"1. The worker designated above, inquires whether the family is receiving relief from the county and clears the name through the local health center files.

"2. If the patient is known to be an indigent, the call is given to a county physician.

"3. If the patient's financial status is unknown or if he is known to to able to pay something for a home visit, the worker explains that a private physician will be sent and that the physician will discuss with him the matter of payment.

"4. The worker then refers the call by telephone to the next physician on the rotating list, giving him the data for Sections A and B of Form 2538. She stamps the date on the physician's card and places the card at the end of the list. She records this call on the 'Report of Patients Referred to Private Physicians.' In case the first physician called cannot go, she continues down the list until she finds a physician who can make the call.

"5. The physician makes at least one visit and renders the necessary service regardless of the patient's ability to pay any part of his fee. During the first visit he fills out Sections C, D, E, and F of Form 2538 and secures the patient's signature on the back of the form. He sends the original copy to the Supervising Medical Social Worker at Highland Hospital who notifies the local health center if a social investigation is requested by the physician.

"II. *During hours when the social agencies are closed.*

All calls during these hours are received by the switchboard operator of Highland or Fairmont Hospital. The procedure outlined in Section I is followed with the exception of clearing each case with the health center files.

"*Known Cases*

"B. Office Visits:

Part-pay patients will be referred to the offices of private physicians only when their financial status is known. The investigation of these patients must be handled through the social service department of one of the above agencies. This department carries out the following procedure:

"1. The social worker who has investigated the patient secures the name of the next physician on the list from the worker in that agency who keeps the list. The latter is responsible for stamping the date on the physician's card, but the social worker referring the case records the referral on her Daily Report sheet.

"2. The social worker discusses with the patient the matter of part or full payment, and an understanding of the amount to be paid is arrived at before the case is referred to the private physician. The patient is also told that he will be expected to pay cash.

"3. The social worker secures from the patient the signed consent for transfer of information, and files this with the social face sheet.

"4. She communicates with the private physician and arranges an appointment for the patient.

"5. The patient is given a Refer Slip signed by the worker, on which are recorded the name and address of the physician and the date and hour of the appointment.

"6. The social worker is then responsible for sending to the physician any medical or social data contained in the health center records, which might be helpful to him in treating the patient.

"7. The case is then closed at the health center for that complaint, and considered a private patient until such time as the physician may refer it back, or until some other medical condition arises for which the patient cannot afford private care.

"It is understood that the physician may request and receive assistance from the health center social worker at any time.

"Full-pay patients who have not been investigated but who request the name of a private physician, will be given the name of the next physician on the list of the agency or told that they may secure several names from the Secretary of the Alameda County Medical Association."

6. *The Wisconsin Plan* is evidently a partial payment plan between the county medical society and the county charities:

"It consists of a contractual agreement entered into between a group of physicians on the one hand and a group of subscribers on the other. The Community Medical Service, an organization apart from the Medical Society, described below, acts only as agent. The physicians as individuals agree to perform such services as they are qualified to perform, receiving their remuneration under the terms of the plan. Those citizens subscribing to the service agree to pay a regular monthly fee which entitles them to complete medical care, including hospital and nursing within certain specific limitations. Chief among these is that they themselves shall pay directly to the private physician for medical service up to a certain amount (depending upon income) before they are entitled to service under the plan."

7. *San Diego County Plan.* In the state of California there are 6,000 dentists, fifty more than half in Southern California; 2,550 are in Los Angeles County and 1,600 in Los Angeles City.

The San Diego County Medical Plan appeals to me as being most adaptable to our immediate dental needs. As I understand it there is a central clearing house social service agency. We could adopt the plan and adjust it to our needs as follows: A patient comes to the dentist's office, and after examination the dentist states his fee. If the patient feels he cannot pay that fee he is referred to this central social service agency which discusses his ability to pay and the amount. A report is rendered to the dentist, and if he cares to adjust his price to the patient's ability to pay he can accept the patient. If he declines, the agency then by alphabetical rotation calls on other dentists until one is found who will accept the patient.

The work is done in a private office and the dentist collects his proportionate fee from the central agency, thereby not lowering his fee charges directly to the patient and utilizing his unused time for these cases. During this

time of stress and strain this arrangement certainly appeals to me as the most economical and efficient. It does not force the dentist to lower fees by unfair competition but allows him to accept his proportionate fee on unused time.

This plan is not primarily an insurance plan, but it does aid in solving the cost of dental care for people in lower wage brackets. Every plan, in the final analysis, must be adjusted to the local needs and yet be elastic enough to fit into the general dental economic picture.

When the best estimate puts the investment in medical and dental equipment in private offices at $1,400,000,000 in these United States, it is time to use this equipment to the fullest extent. Added to this there are 6,000 clinics in the United States, 60 per cent of which have some dental service, or in other words there are approximately 3,000 public dental clinics.

The great problem of reducing the cost of medical care will ultimately come, I believe, by a coordinated educational program for children in the public schools and by every dentist in general practice caring for all the children he can and teaching the highest standards of American dentistry.

The subject of insurance dentistry is creating apprehension in certain quarters, and in my opinion the only way to meet this problem is to create a willingness on the part of every dentist to do his share with the small child, and in that way to do two things: to prevent the wholesale wreckage of teeth in later life, and to inculcate in the little patient such a high estimate of American dentistry that the European system will have no appeal to the future generations.

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FRACTURED AND LOST ANTERIOR TEETH

Treatment and Restoration of Fractured and Lost Anterior Teeth in Children

Report of the Children's Section of the Detroit Clinic Club
W. C. McBride, Director

(Continued from page 752.)

(21) *John Clayton,* Kansas City, Mo.

1. Take x-ray picture to determine extent of apical formation. Make novocain injection and remove pulp, a little short of root end if possible. Seal in treatment of permafix liquid or eugenol for three or four days. Then fill pulp canal with mix of permafix, or aristol and glycerin and seal with cement. Later restore crown of tooth with three-quarter crown, with labial portion cut out and filled with synthetic porcelain.

2. Pulp capped with zinc oxide and eugenol and held in place by orthodontia band filled with synthetic porcelain to restore tooth form, or capping can be held in place with copper band filled with cement. When capping has served its purpose then tooth is restored as in 1.

3. (a) One central incisor replaced by attachments to orthodontia bands on central incisor and lateral incisor, by use of lingual band and using tube attachment to lateral. Can also be restored by attaching dummy to heavy lingual arch wire attached to molar bands by half-round pinch locks.

(b) Two central incisors replaced by use of vulcanite denture with or without palate. Also as second plan in (a).

(22) *H. P. Cole,* Badaxe, Mich.

1. I would remove the pulp under infiltration anesthesia, and fill canal immediately if the accident were less than twenty-four hours previous. Otherwise I would treat as an infected case, and fill canal later. In either case use Kerr's canal sealer. With celluloid tooth form and synthetic, or silicate, restore tooth appearance for six months. If all indications (radiogram and clinical) are negative, proceed with porcelain jacket crown.

2. Restore appearance of tooth with celluloid tooth form and medicated cement, or zinc oxide eugenol paste. Keep in place for as long as is necessary to protect pulp (until nature forms protection), and then porcelain jacket crown. If pulp dies (in spite of, or because of operator) treat as in Case 1.

3. (a) and (b) I would recommend a party plate with one or two central incisors, no clasps and minimum amount of rubber, to be worn at parties and not necessarily to function in mastication. This, of course, until calcification is completed.

(23) *Oliver W. White,* Detroit, Mich.

1. I still advocate the sterilization of root canal and filling, providing patient's resistance is good.

The retention of the natural root is much more favorable to normal development of the dental arch, than mechanically controlled tissue growth. The interference of the tissue growth by extraction is often very serious. In fact, I have examined cases where 75 per cent of the efficiency of the mouth has been lost through early loss of a permanent central incisor or lateral incisor.

2. After protecting pulp by capping, celluloid forms are used to support temporary restoration until such time as permanent restoration is possible.

3. (a) Use lingual bar attachment, with occlusion rests for support of teeth, or Hawley retainer with teeth attached. (b) Same as (a), but each case has to be considered individually.

NOTE.—I do not believe it is possible to have any set procedure of treatment for a given case.

(24) *B. Leachman,* Benton Harbor, Mich.

1. I would extract.

2. I would make a crown from orthodontic band material only large enough to include all of the fracture; protect the pulp with eugenol and zinc oxide paste and set the crown with copper cement. I would not grind the tooth any, if possible to avoid it. If after two or three years there had been no pulp involvement and the x-ray examination showed sufficient secondary dentin, I would apply a porcelain jacket.

3. I would recommend a removable bridge for both (a) and (b).

(25) *E. N. Bach,* Toledo, Ohio.

1. The procedure of many men I know regarding Question 1 is to remove the pulp, fill root and save until such time as it is logical to replace artificially.

2. Have many times made a band nearly as long as the crown to fit the tooth, covering the broken surface with carbo-eugenol and flowing cement over the remaining areas to fill the band.

3. (a) Have made a cast gold retainer such as used in orthodontia with Steele's facing, and if roots of normally contacting teeth are nearly or completely developed, banding these teeth and replacing missing teeth with Steele's facings.

(b) Same as (a).

(26) *Celia Rich,* Nashville, Tenn.

1. If by "desensitized," "devitalized" is meant, I should advise that pulp be removed with all aseptic precautions as soon as possible and a canal filling be inserted using a nonirritating material into which some antiseptic, such as thymolized iodine, has been incorporated. Keep tooth under strict radiographic observation until it becomes necessary because of its condition, or desirable for any reason, to remove it.

If by "desensitized" is meant there is no sensation at the point of exposure, I should test to see whether any slight vitality could be demonstrated

in pulp, and if any were present proceed as under (2) in the hope that this live pulp tissue might yet build a complete root end.

2. Dry and sterilize fractured surface and place over exposure small amount of paste of oxide of zinc and oil of cloves. A tiny concave disc of thin 22K gold (having already been prepared) is placed over the paste, being careful to exert no pressure on the pulp. The whole is then covered with some kind of strongly adhesive cement. This will last a long time in some mouths, but in other children where there is the habit, for instance, of taking a pencil between the teeth or playing very rough games, it will not serve. When there is difficulty in keeping cement in place, fit a band of 22K gold, as thin as 24 gauge, and as narrow as possible on labial, protruding a short distance incisally beyond fractured edge. After placing protective paste and disc as above, cement band over tooth, filling open end with cement. This is disfiguring but is the safest procedure for maintaining vitality of pulp until root apex is complete, after which of course a porcelain shell crown may be made.

3. Maintain space in any simple manner with or without missing teeth attached to appliance (a "palate plate" may be used) until child is of age when appearance must be considered, younger for girl than for boy. By that time neighboring teeth will be well calcified, and carefully constructed three-quarter crowns or other conventional bridge attachments can be made, to carry missing central incisors. Delay this procedure as long as is practical.

(27) *R. L. Barris,* Hillsdale, Mich.

1. In this case I would use a local anesthetic, remove the pulp and fill the root canal, attempting to fill the apical end.

2. In this case I would use a small inverted cone bur and get what retention I could along the line of fracture and flow over this carbo-eugenol paste or a paste made from zinc oxide and eugenol. I would then fit an orthodontic band to the tooth and cement it in place, covering the fractured part of the tooth with cement, let remain so six months and then test for vitality. In most cases the tooth will remain alive. If the nerve dies, I would treat it the same as Case 1.

3. (a) I would fit orthodontic bands to the central and lateral incisor and use a Steele's backing and facing as a pontic to replace the missing tooth. I like these better than the regular wire space retainer because of the appearance. In most cases these are very satisfactory.

(b) This case would be treated the same as case (a) except two central incisors would be supplied instead of one, with the orthodontic bands fitted to the lateral incisors. The Steele's facings in the above cases (a) and (b), can be changed to longer ones to improve the appearance as the lateral incisors grow further into the mouth. In case the lateral incisors were late in erupting and had not erupted at the time of the loss of the two central incisors in case (b), I would refer the patient to an orthodontist.

(28) *W. Bossert,* New York, N. Y.

1. Removal of tooth is best procedure in this case. Although this is rather radical, is it not more advisable to extract the tooth now, than to wait until

later when an extraction must be performed, and the patient's health has been injured?

An x-ray examination will show size and shape of lateral incisor pulp. If small enough, or there is sufficient room from mesial and distal borders of crown to warrant shallow grooves, the best procedure would be to make a three-quarter crown for the lateral, a Steele's backing and facing as "dummy" tooth, and a lug resting on lingual of left central incisor (assuming right central incisor is extracted). If it is impossible to make a bridge, a space retainer should be used.

2. Scrape dentine very lightly over affected area and apply paste of thymolized calcium phosphate and eugenol. Seal with cement. Vitality tester to be used periodically, in conjunction with periodical x-ray examination. It would be best to wait until tooth (root) is fully formed, and if tooth tests normal, a porcelain jacket crown is placed to restore broken off tooth structure.

3. (a) To be restored same as in 1.

(b) A space retainer may be put in place; or a three-quarter crown on right lateral incisor, a three-quarter crown on left lateral incisor, 2 Steele's facings and backings as "dummy" teeth. Only shallow grooves to be ground into lateral incisors.

When the roots of the lateral incisors have fully formed, and pulp has sufficiently receded to permit making of deeper grooves, a permanent bridge may be constructed.

(28) *H. B. Shafer,* Anna, Ill.

1. I would have an x-ray examination made and remove pulp and restore with a porcelain filling. Await results.

2. Protect with porcelain filling until patient is old enough to warrant porcelain jacket crown.

3. Construct plate and maintain space until conditions warrant permanent bridge.

Or place temporary bridge with orthodontia bands.

(29) *Willis H. Grinnell,* Boston, Mass.

1. Remove pulp, ream canal if necessary, treat if necessary and fill. Check with x-ray examination over a period of time to be reasonably sure result is to be permanent. Jacket crown can be placed when operator is satisfied as to permanency.

2. Try to save life of pulp by a protective covering such as a band which may be filled with a nonirritating cement. Vitality tests from time to time; x-ray examination to check root formation. If successful, tooth can be restored by porcelain inlay or jacket crown. If vitality is lost, proceed as in Case 1.

I have had two cases of this type. In one, the space had closed up about one-third. I placed a lingual wire with finger springs to open the space. When this was accomplished, the patient was sent back to a general practitioner who made a small vulcanite plate with tooth attached as a temporary restoration.

It is planned to replace the tooth with a porcelain bridge when the boy is older. In the second case I made bands for the maxillary first permanent molars to which was soldered 16 gauge lingual arch wire. A small gold saddle to hold a porcelain crown was soldered to the wire in the proper place and the whole placed in the mouth. It is planned to replace this at a later date with a more permanent form of restoration.

3. Only case I have is one where loss of central incisors occurred before eruption of lateral incisors. These are now coming in and are rather wide teeth; I am going to try to bring them together. The canines will probably erupt in contact with the lateral incisors and when premolars have erupted, I believe the mouth will look very well. Some shaping of canines may be done later if appearance seems to warrant it.

(29) *J. Kauffman,* New York, N. Y.

1. Conserve pulp if any vitality remains. If however by "desensitized pulp" you mean nonvital, I would remove it and institute the necessary root canal treatment and filling. I would then wait at least three to six months to observe, by clinical and radiographic examination, the condition present. If favorable I would advise a porcelain incisal; if too much discoloration occurred I would change to a porcelain jacket crown with the aid of a cast gold crown.

2. I would first medicate and make every effort at sterilization of dentine. Then place in some sort of an onlay or filling to avoid removal of pulp for purposes of observation. After three to six months would advise gold inlay and porcelain combination according to the nature of the fracture and the amount of lost tooth substance, with the prime object in view of retaining healthy (noninfective) vitality; and esthetics as a secondary factor until after the tooth had fully developed. Upon maturity the patient could then decide for himself or herself as to any change desired.

3. (a) (1) Temporary removable denture until completion of roots of neighboring central and lateral incisor using clasps or Jackson arch. (2) Or a palatal bar extension carrying central pontic and supported by gold crowns on temporary canines. (Please understand that I never place a gold crown on a permanent canine and seldom on any permanent tooth.)

(b) (1) Same as (1) above in (a). (2) Palatal bar extension using deciduous canines and any other adjacent deciduous teeth posteriorly which could be safely selected.

(30) *Harold J. Leonard,* New York, N. Y.

1. Remove pulp by conductive anesthesia. Fill root canal, after opening by surgery, as for root amputation, so that a solid core of gutta percha smooth and sealed at the apical end remains. The tooth may then be crowned with a porcelain jacket made to cover to the cervix so as to anticipate normal recession with age. For some children a general anesthetic may be required for part of this operation.

2. Cover portion overlying pulp with sedative cement, such as eugenol and oxyphosphate powder mixed. A tiny strip of thin pure gold may be used

over the pulpal wall to hold the dressing in place during subsequent operations. A gold cap is then made which goes down on the tooth only far enough to give retention. This is cemented on and left for several years until pulp is sufficiently receded to permit the insertion of a gold or porcelain inlay or porcelain jacket as the case may require.

In both of these cases the parents must be warned of the possibilities of failure and the necessity for frequent examinations.

3. Make a small denture to substitute for the missing tooth or teeth if the child's parents demand that the space be filled. Otherwise let it go for a few years until the child demands it for purposes of appearance. By the age of fifteen or sixteen years, a bridge can be made using three-quarter crowns on the lateral incisors if they are large and firm, otherwise extending to the canines. The partial denture serves many patients well until a much later period. In case there is a tendency for the lateral incisors to shift forward if no denture is inserted, some form of retaining appliance may be necessary, or the denture may be necessary for purposes of retention as well as appearance.

(31) *W. M. Dailey,* New York, N. Y.

1. Take x-ray pictures, and remove pulp, and fill root canal. Porcelain jacket crown recommended.

2. Porcelain jacket crown allowing space for pulp capping.

3. *Very difficult cases and unsatisfactory at best.* Financial and social position would determine to some extent the course of action. Artificial restoration can be considered on child's behavior. Should the jaw be of normal growth (lateral), case could be allowed to wait.

I have seen many cases of one maxillary central incisor where space closed completely.

(32) *H. E. Friesell,* University of Pittsburgh, Pittsburgh, Pa.

1. Remove the pulp under the usual aseptic precautions and with proper anesthesia. Treat mildly until assured that tissues at apical end of root have healed. When root filling seems advisable, flood the canal with liquid thymol; absorb all excess possible; insert as a filling one of the root canal pastes, such as Kerr's neobalsam compound, medi-cement, Buckley's thymolized calcium phosphate, or something of that nature. Seal mouth of canal carefully with cement. Use partial crown or banded crown to maintain space until permanent teeth are in place and age of patient and condition of other tooth roots make a more permanent operation possible should it become necessary, which is very likely to be the case. If the tooth cannot be controlled and an alveolar abscess develops, tooth should be extracted and a suitable substitute for the individual case used as a space retainer until the age of the patient permits a more permanent operation.

2. (a) Treatment should be instituted at the earliest possible time after the accident, in order to avoid: (1) the development of hyperemic changes in the pulp due to the exposure of the fibrillae and the loss of tooth structure; (2) the ingress of bacteria and toxins via the unprotected tubuli.

(b) The emergency treatment. Dry the fractured surface with cotton and warm air and cover at once with liquid thymol (a crystal melted with moderate heat). After a few moments the excess is absorbed, and the surface, especially that over the pulp, is covered with a zinc oxide-thymol mixture, which is softened and flowed over the surface, without pressure. After it has set, the excess may be trimmed off and a coating of a good hard varnish applied. Instructions should be given to avoid use of tooth, lest the protective covering be removed.

(c) Later treatment. When the traumatic discomfort has ceased, a crown (gold shell or open face or three-quarter) is fitted to the tooth and cemented to place so as thoroughly to protect the fractured surface.

(d) Follow-up. The tooth is tested for vitality; its color noted; and appearance in x-ray picture is followed, pending the completion of the apex, and the formation of sufficient secondary dentine about the pulp to permit the placing of a porcelain jacket crown, which is contemplated at a more mature age.

3. (a) Space retainer, or a partial denture to wait development of the teeth. Use clasps if necessary for retention. Plate to be enlarged at suitable periods to take care of any expansion of the arch. At a sufficiently mature age, a bridge is placed.

(b) A partial denture, as in (a). At a sufficiently mature age a bridge to be placed, if the lateral incisors will carry one. Otherwise a removable appliance (denture) of some type.

(33) *Phelps J. Murphey,* Dallas, Texas.

1. I would invariably recommend one of two things: extraction of the pulp, filling of the root canals, retention of the tooth if successfully sterilized until the child is twenty years of age, then subsequent extraction and bridging; or construction of a vulcanite denture with facing thereon to serve as a space retainer and to preserve the esthetic effect.

2. (a) If patient is seen immediately after fracture, would remove any débris carefully with cotton pellet, immediately instituting warm saline solution mouth wash every three hours for four or five days, cautioning the patient not to take extremely cold or hot foods or liquids. If there is no pain, would construct orthodontia band covering fractured portion, using for this dee-ortho band material size 0.003 × 0.70, and contouring and festooning to adapt closely to the tooth form without preparing tooth. Would then solder incisal, trim off excess, and polish the band. Then clean the tooth carefully and cement the band with carbo-eugenol, being careful not to apply any pressure. If pain is encountered in a week or so, cap may be removed and new carbo-eugenol sealed in. After the cap has been worn from three to six months, it is removed and in 95 per cent of our cases, secondary dentin has been formed so that it is now impossible to see the pink of the pulp. The cap is then recemented with Smith's copper silicate cement, light (4) yellow. Every year the band is removed and recemented. We have been successful in one particular case in retaining the vitality of the tooth for a period of

eight years to date. At twenty years of age, the cap may be removed and a porcelain jacket crown constructed.

(b) If the tooth has been fractured for some time, we proceed in the usual way, only first testing the tooth with a vitality tester and making an x-ray picture to see whether there is any apical infection. If so, the tooth is extracted and a space retainer constructed.

3. (a) One maxillary central incisor lost, would immediately retain space, or, if space is already partially closed, would suggest lingual appliance with auxiliary springs to open space to normal size. Thereafter would retain opening by Steele's facings soldered on the appliance.

(b) Two maxillary central incisors lost, would proceed as above and construct either vulcanite space retainer or attach Steele's facings to lingual appliance for retention until the patient is twenty years of age.

(34) *Alfred Walker,* New York, N. Y.

1. My method is to curette away necrotic pulp and after hemorrhage has been controlled, place cotton dressing saturated with eugenol and seal it over with cement, removing in twenty-four to forty-eight hours. If vitality has been retained, and after cleansing field, seal over with paste of eugenol and zinc oxide without pressure, and cover with thin mix of cement to insure marginal seal. Test pulp six to ten days later. If pulp is still vital, dismiss patient and see again in ten days and repeat pulp test. This procedure to be followed for thirty days, assuming that pulp remains alive. If at end of thirty days vitality continues, a swedged platinum cap is cemented over the stump. Pulp is tested periodically every three months. Should vitality of pulp be completely lost at any time, pulp canal treatment is instituted.

2. Exposed dentin disinfected with either phenol or eugenol. Paste of zinc oxide and eugenol placed over exposed dentin and this sealed with thin mix of oxy-phosphate of zinc cement. Periodic pulp testing as in No. 1.

3. Strange to say, in all of my thirty-five years' experience, I have never encountered such a condition, and the procedure for handling such a situation I confess is somewhat baffling. I realize the importance of making the restoration one that would permit of normal jaw development and at the same time prevent misalignment of other teeth. While several procedures suggest themselves to me I would hesitate to make recommendations, preferring to leave that to those who have had actual experience.

(35) *Corvin F. Stine,* Chicago, Ill.

1. (1) X-ray examination of tooth to determine amount of root development, possibility of root fracture, etc.

(2) Administer a local anesthetic (usually by infiltration).

(3) Apply rubber dam, if possible.

(4) Sterilize entire field for five minutes (by clock) with 4 per cent chlorine solution or hexylresorcinol.

(5) Remove hypertrophied pulp with large, sharp spoon excavator.

(6) Open into the pulp chamber with a sharp bur.

(7) Remove pulp from pulp chamber with a sharp, spoon excavator.

(8) Remove the pulp in root canal with a sharp, round bur, slightly larger than the root canal. Do not advance further than one-third of the length of the root (meaning one-third of the length of the root at the time of the operation and not one-third of the length of a completely developed one).

(9) Wash out grindings, blood, etc., with a 4 per cent chlorine solution.

(10) Flood with eucalyptol compound (Buckley).

(11) Place eucapercha in eucalyptol compound, which will flow into all parts where the eucalyptol compound has been.

(12) Form large gutta percha cone or cones into a soft mass which will approximately fit the pulp chamber.

(13) Soften above in flame and place in the eucapercha, allowing it to remain there from three to five minutes.

(14) Gently pack into place forcing out excess eucapercha.

(15) Remove excess eucapercha with cotton saturated in alcohol.

(16) Fill with cement.

(17) Check with x-ray pictures.

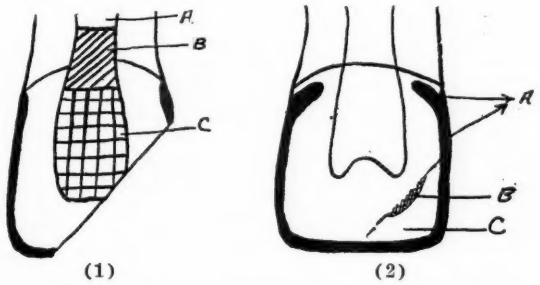


Fig. 10.—(1) *A*, pulp; *B*, gutta percha; *C*, cement. (2) *A*, gold; *B*, capping material and zinc cement (beneath gold or silicate); *C*, silicate cement facing.

2. (1) X-ray examination.

(2) Keep area dry.

(3) Sterilize from three to five minutes with a 4 per cent chlorine solution of hexylresorcinol.

(4) Place very thin layer of pulp capping material (a, b, c) over dentin where pulp tissue can be distinguished. (a) Dentinoid. (b) Thymolized calcium phosphate mixed with oil of cloves. (c) Dampen area with eucalyptol compound. Place thin piece of gutta percha over the area.

(5) Flow a mix of bland zinc cement over most of the fractured area.

(6) Restorations: (a) Silicate cement crowns. (1) Fit suitable celluloid crown form to tooth. (2) Fill with silicate cement and carry it to place.

(b) Cast gold restoration: (1) Carefully take impression of tooth in modeling compound, confining it with a fitted copper band. (2) Make model by using model kryptex. (3) Build up pattern in wax, covering the entire lingual, and extending onto the mesial and distal surfaces far enough to cover the greatest mesiodistal diameter. (4) At gingival extend little short pro-

jections onto the labial. (If labial surface of the restored area is to be covered with silicate cement, cut away this portion of the wax.) (5) Cast in hard, clasp metal, so that the restoration can be sprung into place, and the metal will return to its original shape. (6) Fit, polish, and cement into place. (7) Place silicate facing, if necessary.

3. (1) Lost one maxillary central incisor.

(2) Lost two maxillary central incisors.

(a) Maintain a correct relation of remaining teeth through orthodontic appliances until there is sufficient vertical space to place in: (1) a fixed appliance (fixed bridge); (2) a removable appliance (removable bridge).

(36) *Harry A. True,* San Francisco, Calif.

1. (1) X-ray examination to determine length of incomplete root.

(2) Novocain anesthesia; conduction or infiltration.

Fig. 11.

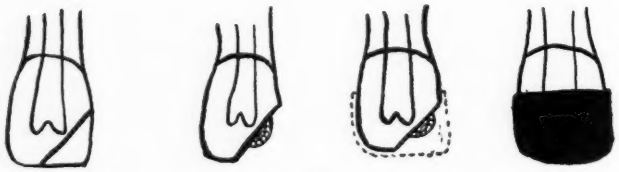


Fig. 12.

(3) Large round sharp bur to remove pulp tissue to near end of incomplete root.

(4) Arrest hemorrhage; trichloracetic acid.

(5) Dressing; phenol compound, two days.

(6) Fill apical portion with eucapercha and large short gutta percha cone.

(7) Restore with gold inlay, anchored in root canal.

2. Diagonal fracture.

(1) Rubber dam, held in place by modeling compound stuck to labial and lingual surfaces.

(2) Cleanse fractured surface with warm alcohol.

(3) Apply zinc oxide and eugenol paste; a thin layer of thick paste overlapping pink area.

(4) Flow oxyphosphate of zinc cement over paste and cover all exposed dentin.

(5) Trim opposite proximal, labial, and remaining incisal surfaces sufficiently to allow wax pattern for cap crown.

(6) Cast and set cap crown.

(7) In patient's teens restore with porcelain jacket.

3. Lost central incisors.

(1) One or two tooth denture—"stay plate." (a) Allows freedom of lateral incisors while erupting.

(2) As soon as lateral incisors are erupted sufficiently, construct bands on them and replace central incisors with porcelain facings.

(37) *F. E. Shroeder,* Toledo, Ohio.

1. Case Report: The accident occurred two days before I saw the case, the pulp was laying open. The pulp chamber was cleaned out as you would with a deciduous tooth under local anesthesia and sterile procedure. Then without pressure a treatment of iodoform, zinc oxide, and eugenol was put in and allowed to remain. I put a cement cap over the treatment just for added support. Later I built up the tooth with a Caulk crown form and synthetic porcelain.

2. No reply.

3. No reply.

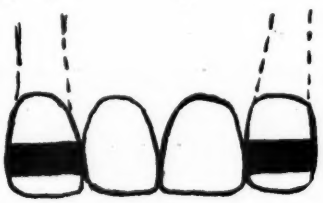


Fig. 13.

(38) *Sidney Asher,* Chicago, Ill.

1. Clear indication for extraction (in my hands).

2. At all costs preserve the vitality of the pulp. Exposed dentinal tubules must be sealed from the oral secretions. Silver nitrate cannot be applied here for two reasons: first, because of its irritating effect upon the dental pulp; second, because of possible discoloration.

This case will require a porcelain jacket some time in the future, perhaps, at the age of fifteen years. Therefore, no permanent restoration is possible at this time.

Certainly, no large restorations are indicated, which will necessitate further removal of large amounts of tooth substance.

In some cases contact point will have to be established to prevent drifting of the lateral incisor. This will depend upon the judgment of the operator; not all cases require this measure. Operators, with large clinical experience, recall many cases in which there are spaces between the incisors, with no drifting, and cases in which no contacts have been restored between the incisors, with no drifting. Of course, this does not hold true with the posterior teeth!

Realizing these points—I have successfully treated this type of case by removing a slight amount of the remaining enamel undercuts with a small, fine stone; the restoration is a thin veneer casting of the three-quarter or open face crown type made by the indirect casting technic. The prime purpose of the restoration is to seal effectively the exposed dentin from the oral secretions. No attempt is made at a full restoration of the missing tooth substance—because a large bulk of gold might endanger the vitality of the dental pulp, from thermal shock.

3. No reply.

(39) *C. W. Wilson,* Detroit, Mich.

1. A pulpotomy is done extending to approximately 1 mm. below gum line; this is done from the mesial or distal and not from the *lingual* surface.

Restoration: three-quarter jacket crown. (The labial surface is removed and shoulder established the same as for a jacket. The same is done on the mesial and distal. Be careful not to involve any more of the lingual surface than is necessary to establish shoulder. The fractured incisal surface is trimmed down, leaving a preparation similar to jacket on the *mesial, distal* and *labial* and *incisal.*) Take impression and bake it as for a full jacket. The advantage of this preparation is that if further treatment on the root canal is necessary at any time in the future, it can be done through the lingual surface in the usual manner without destroying the restoration, and the labial appearance is the same as that of a full jacket.

2. Zinc oxide and eugenol in a Caulk toothform until we are sure the tooth will retain its vitality. Then lingual onlay until the child is old enough to choose permanent type of restoration desired.

3. One central incisor missing—orthodontic bridge.

Two central incisors missing—horseshoe type plate with clasps on first permanent molars, open at mesial to avoid necessity of grinding in the interproximal. The denture is made of *Vydon.* This material is used because if it is ever necessary to change the teeth or if one is fractured from the denture, it can be accomplished merely by heating the tooth and the denture does not have to be *vulcanized over.* In the same manner new clasps can be added to the old denture in any position desired. No *vulcanization* is necessary after the original denture is completed.

(40) *G. E. Morgan,* Milwaukee, Wis.

1. Extract.

2. Attempt pulp capping by placing celluloid cap or gold band or gold cap over tooth. Cement the cap or band on the tooth after first placing a mixture of chemically pure zinc oxide and eugenol over the nearly exposed pulp. The mixture should be made as thick as possible; then the mass should be squeezed in gauze to expel the eugenol. The cap should be left in place until there is an opportunity for the pulp to protect itself by the deposition

of secondary dentin. If this procedure is not successful—if the pulp does not remain vital—then I would extract. If it remains vital, and secondary dentin is formed, a more permanent restoration, such as a porcelain jacket crown, may be applied when the child is older.

3. In the average child of eight years the approximating lateral incisor if it be deciduous is about to be lost or if it is a permanent incisor it has only been in a short time, and in either case the lateral incisor should not be used as an abutment tooth. If the approximating central incisor alone is used as an abutment for a temporary bridge, it is very likely to become rotated. Therefore it is advisable to eliminate the use of the lateral incisor and central incisor as abutment teeth for the restoration.

A restoration as shown in Fig. 14 supplies the missing teeth and proves very satisfactory. The eruption of the teeth on either side of the ones lost is not interfered with. The esthetic value is good. The second deciduous molars are the best teeth for anchorage in a child of eight years. This plate

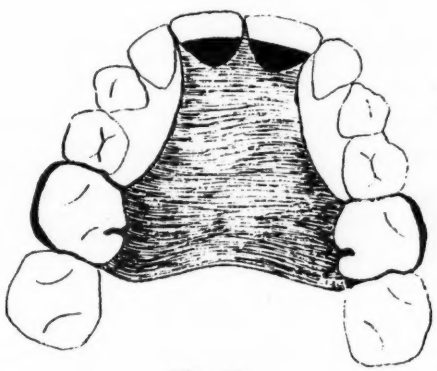


Fig. 14.

or denture may be renewed and the attachments placed on the first permanent molars when the second deciduous molars are exfoliated. This can be worn until the child is old enough to warrant replacement with a permanent bridge. It is made by placing Crozat crib attachments over the second deciduous molars. The palate is made of metal or rubber as the operator may choose. Note that the palatal portion does not impinge on the gingiva between the missing and abutment teeth; this is important.

(41) *Barnett Malbin,* Detroit, Mich.

1. No reply.

2. No reply.

3. Being an orthodontist accounts for the above negation. I have had many cases of lost anterior teeth, however. Usually I make a full palate denture attached to the second deciduous molars preferably, or the first permanent molars, with a Crozat crib appliance. This can be changed from time to time as growth demands. This serves both esthetics and space maintenance at a very reasonable cost to the patient.

(42) *W. C. McBride,* Detroit, Mich.

1. Take x-ray picture to note apical condition and possibility of root fracture. With local or general anesthesia perform pulpotomy, that is, remove pulp tissue just beyond the bulbous portion of the pulp chamber or canal. Stop hemorrhage with hydrogen peroxide and phenol. Flow over the stump Kerr sealer powder mixed to a paste with a solution of glycerin-of-iodine and seal with cement without pressure. Restore temporarily with orthodontic band and porcelain tip or with gold inlay with porcelain window.

2. Take x-ray pictures to note conditions mentioned above as well as to see the proximity of the pulpal horn to the line of fracture. Usually these present as emergency cases, and I treat them as such by placing zinc oxide and eugenol paste in a Caulk's celluloid form and covering the tooth. After a period of a week or ten days when the soreness and swelling of the adjacent tissue have subsided, I sterilize again, cap the pulp and replace the lost portion by the above method, or with a three-quarter onlay with synthetic angle. Later on, at fifteen to sixteen years, a porcelain jacket or porcelain is substituted.

3. Provide space maintenance primarily either with a space maintainer or with an orthodontic bridge. The latter is made by banding the adjacent abutment teeth with orthodontic or gold band material and soldering a Steele's backing to a connecting wire soldered at one end and received in a tube at the other. Many find vulcanite dentures useful here as well as lingual arches with backings and facings attached. At fifteen years or thereabout a three-quarter crown bridge or removable bridge is substituted.

(43) *Morris B. Katzoff,* Cedar Rapids, Iowa.

1. Under pressure, procaine, ethyl chloride or nitrous oxide anesthesia remove the bulbous portion of the pulp to about a line opposite the gum line. Use phenol or formocresol to control hemorrhage. Fill pulp canal with "Triolin" (King's Specialty Co.) and cover with a hard cement, being careful not to exert pressure. A band around the tooth may or may not be used just as the case requires, and sometimes a "cap" or a half crown is better than a band.

2. Use phenol over fractured area. Place Jodo-Formagen, and over this a hard cement. An orthodontia band may be used, with kryptex to build up the broken incisal corner.

3. No reply.

(44) *John Scholten,* Cedar Rapids, Iowa.

1. Anesthetize by injection, procaine preferred. Clean by polishing, both central and lateral incisors if erupted; place rubber dam. Wipe teeth with grain alcohol. Sterilize exposed portion of pulp with modified phenol (Buckley's formula). Remove bulbous portion of pulp, the portion within the crown of the tooth, with a small, sharp, cleoid excavator. Arrest hemorrhage with modified phenol and place a dressing of a paste made of C. P. zinc oxide and equal parts of guaiacol and eugenol without pressure. Seal cavity with a good cement.

2. Make band using orthodontia band material. Use modified phenol over fracture. Place a thick mix of neobalsam over fracture, cement band to place and cover dressing.

3. No reply.

(45) *A. Bordon Taylor,* Notts, England.

1. X-ray examination; an x-ray picture may disclose a fractured root. The treatment is at best empirical and should be aimed at preserving a vital pulp for apical formation. I have had a very successful result with a similar case. The exposed pulp was capped with a mixture of zinc oxide and thymol crystals fused on a spatula. A pinch band was fitted and filled with cement to prevent any damage to the dressing. The pulp retained its vitality and the apex closed. Later the tooth was devitalized and filled. To carry out an apicoectomy is in my opinion rather risky, as a remnant of the tooth sac may be left with a risk of pathologic sequelae. If the attempt at pulp preservation fails, the tooth should be removed.

2. X-ray examination. If the surrounding tissues and the root are in good condition, the procedure is straightforward; that is to say, in England it is almost standardized. An impression is taken and cast. The cast is built up to resemble the tooth form, and a metal cap is cast in standard silver (to be gilded) acolite, aluminum or precious metal. A dressing of zinx oxide and eugenol paste is placed over the pulp and the cap cemented with Ames black copper cement. This is retained until the child is about ready to leave school, when a porcelain inlay is made. In some cases the cast cap can be improved by cutting a window in the labial surface.

3. (a) Here we have to consider three possibilities: lateral incisors unerupted, erupting or erupted. In the first we must wait until the permanent incisors erupt. In the second, space retention is necessary and a vulcanite plate should be used until the lateral incisors are in. Maintain the space with bands and bar maintainer.

(b) Same treatment applies as in the above. Of bridgework, I have had little experience, but if this is contemplated it should not be set in hand before the age of fourteen years. For the youth the one tooth denture is preferable, as I can well remember players of rugby football who had missing incisors and one tooth dentures which were removed for the fray.

RECOMMENDATIONS

The members of this section, from a complete analysis of all the data at hand and with due regard for those with whose opinions it differs, make the following recommendations for the treatment of the cases outlined:

(1) Make radiographic examination, if possible, to determine the apical condition and the possibility of root fracture. If accident has occurred within twenty-four hours, a pulpotomy is indicated. If a greater lapse of time, devitalization should be effected. Resection may be advisable in some cases.

Pulpotomy.—Sterilize field with iodine solution. Anesthetize with novocain—subperiosteum. Remove bulbous portion of pulp (to 2 mm. below gum margin) with No. 7 round bur. Remove remainder of bulbous portion with spoon excavator. Control hemorrhage. Cauterize stump with hot straight plugger. Wash with hydrogen peroxide. Cover stump with mixture of Kerr sealer powder and glycerin-iodine solution (this material being used because it does not harden, remaining in a more or less plastic state until pulp is healed). Cover with mixture of Kerr sealer powder and liquid. Cover with sheet gutta percha and cement.

Temporary restoration: Leave as above for one to six months. For esthetics during this period, a Caulk's form with silicate may be used to restore incisal. Make radiographic picture when patient returns. Restore with three-quarter onlay with silicate window. To stabilize the restoration further, a groove may be cut at the cingulum or pins may be used in the incisal.

Permanent restoration (at fourteen to sixteen years): Three-quarter porcelain jacket crown, porcelain jacket crown, Davis crown, gold shell crown.

(2) Make radiographic examination, if possible, to determine proximity of horn of pulp to the line of fracture, the apical development and the possibility of root fracture.

Isolate and dry with cotton pellets. (Do not use hot or cold air or alcohol.) Apply normal saline solution or any of essential oils, and dry again with cotton pellets. Cover with medi-cement or zinc oxide-eugenol paste in Caulk's form for one week to ten days.

Temporary restoration: Three-quarter onlay with silicate window. Gold inlay hollowed to permit pulp capping.

Permanent restoration (at fourteen to sixteen years): gold inlay, gold inlay with porcelain window, porcelain inlay, porcelain jacket crown, gold shell crown.

(3) Temporary restoration: orthodontic bridge; full palate denture without clasps.

Permanent restoration: fixed three-quarter crown bridge; removable bridge.

THE MURRY AND LEONIE GUGGENHEIM DENTAL CLINIC*

ANNUAL REPORT, 1932

SUPPLEMENTARY STATEMENT

TWENTY-ONE schools in the vicinity of the Clinic are receiving dental care. Selection of pupils is on a basis of financial eligibility since the service is entirely free. As each school is enrolled, the needy children from the kindergarten and first four grades are registered for routine dental care; emergency treatment, however, is offered to children in the higher grades. With the opening of each school year, the pupils entering kindergarten are registered, and the care of those already registered is continued. Thus in four years the Clinic will be giving regular dental care to all children in the grammar grades and will be in a position, among other things, to furnish dental certificates to those of the proper age desiring to take out "working papers."

An effort is made to enroll also the preschool children in the district being served by the Clinic. This is done by getting the names of younger brothers and sisters of children already registered, and asking parents to bring them to the Clinic. Day nurseries in the neighborhood are also offered dental care for their protégés. The condition of the mouths of a majority of kindergartners indicates the urgent need of beginning dental service at an age well below that for entrance to school.

From the opening of the first unit in December, 1929, to December 31, 1932, 8,993 pupils have been registered. The Board of Education provides a motor bus for the transportation of the children to and from school. Individual appointments are made and each group of children is accompanied by a teacher. Each child is examined in a department provided for that purpose and is given a routine x-ray examination. Additional x-ray pictures are taken whenever indicated.

Each completed case is recalled at six-month intervals for reexamination, prophylactic cleansing, and any operative or surgical work found to be needed. X-ray pictures for the detection of incipient decay are taken at least once annually.

The accompanying statistical report indicates that only 2½ per cent of children examined have teeth free from caries; in other words 97½ per cent of the children examined have defective or decayed teeth. This is the highest figure reported in examinations of school children's teeth in New York or elsewhere; figures given in other examinations range from 90 to 95 per cent. It is the opinion of members of the Advisory Committee that this does not mean that the children in this city are necessarily more susceptible to dental disease, but simply that with the very rigorous examination made in this Clinic, including the routine use of the x-ray examination, cavities are found which might be overlooked in less thorough examinations.

An important feature of the Clinic is the tooth brush drill room. This room is fitted with ten special basins with running tepid water, and is also provided with

*422 East Seventy-Second Street, New York, N. Y.

racks holding numbered test-tubes for the tooth brushes. Each child is registered for tooth brush drill at some appropriate time during his visits to the Clinic and is provided with an inexpensive tooth brush. The children are taken to the tooth brush drill room in groups by a dental hygienist who conducts the drill giving individual instruction as needed. Results have been most gratifying.

The School for Dental Hygienists, which enrolled its first class in September, 1932, is an integral part of the Clinic. Its first class is now engaged in giving prophylactic cleansings in the Clinic, conducting tooth brush drills, making mouth examinations, and taking x-ray pictures of the children's teeth.

A course for training dental assistants has been established in conjunction with the Advisory Board on Industrial Education of the Board of Education. This is a course covering one semester of the school year. The course for the first seven weeks is given at this Clinic and consists of a series of lectures in assisting at the dental chair, sterilization, etc., and practical work in these branches, also surgical assisting, developing and mounting x-ray films, filing, etc. The remainder of the course is given at the Central Commercial Continuation School in East Forty-Second Street. This part of the course is devoted to bookkeeping, shorthand, typing, office management, etc., and practical training in the laboratory phases of inlay technic.

REPORT FOR PERIOD FROM JANUARY 1 TO DECEMBER 31, 1932

Total visits			58,467
First visit in year			7,178
New patients			
Age 1 to 5	725		
Age 6 to 12	3,535		
Over 12	340		
Total			4,600
Oral Diagnosis Department			
Total visits			14,971
X-ray pictures			35,130
New caries			44,692
Recurrent caries			490
No operative work needed			289
Free from caries			117
Orthodontia needed			206
Refer to rhinologist			639
Operative Department			
Total visits			43,640
Treated by hygienists			8,777
Treated by dentists			35,495
Fillings			
Temporary — simple*	2,502		
Temporary — pulp capping	271	2,773	
Permanent†		53,353	
Total			56,126

*Simple temporary fillings are chiefly sedative dressings inserted in teeth found to have exposed pulps and requiring extraction.

†Each surface of a tooth involved counts as one filling.

Fillings polished			22,103
Cavity preparation and gutta percha			5,852
Ag NO_3			4,002
Oral Surgery Department			
Total visits			10,169
Extractions			
Deciduous	12,515		
Permanent	2,649		
Total			15,164
Postoperative treatment			963
Anesthetics			
Local			
Procaine	5,734		
Ethyl chloride	311	6,045	
General			
N_2O and O	2,190		
Ethyl chloride	306	2,496	
Total			8,541
Total patients registered December 31, 1932			8,993
Cases completed			4,796
Total operations			148,117

ABSTRACTS OF
CURRENT LITERATURE

NUTRITION AND PEDIATRICS

By Samuel Adams Cohen, M.D., New York City

It is the purpose of this Journal to review so far as possible the most important literature as it appears in English and foreign periodicals and to present it in abstract form. Authors are requested to send abstracts or reprints of their papers to the publishers.

Sunlight and Health. Haven Emerson. Am. J. Public Health **23**: 5, 1933.

Although sunlight was used in the treatment of diseases as far back as Hippocrates, Emerson states that modern interest in sunlight as a therapeutic agent began in 1893 when Finsten utilized sunlight in the treatment of cases with lupus and again in 1903 when Rollier reported good results with sunlight treatment of surgical tuberculosis in Switzerland.

According to Emerson, insufficient sunlight is responsible for only one clearly defined clinical entity—rickets. Rickets is a general disorder of metabolism affecting other tissue besides bone, and the author further states that disturbances of dentition and a greater susceptibility to caries and malocclusion of the jaws are some of the by-products of rickets and furthermore wise feeding alone will not prevent rickets in the absence of sunlight unless of course a substitution for solar radiation is used.

Excessive sunlight is known to cause two types of disturbances: (a) physical lassitude which in the main is due to heat, and (b) nervous irritability due to light radiations particularly. In the deserts and in the tropics man's survival always depends upon his covering himself from the heat of the sun even when by adaptation his skin is capable of protecting him against overstimulation of the light rays. Similarly in temperate climates injudicious exposure to the sun by white skinned people, although not to a degree to cause sunburn, not uncommonly induces irritability, sleeplessness, loss of weight and a variety of nervous phenomena.

The writer brings out an important point when he states that sunlight also has a psychologic effect in that it induces a sense of well-being in the individual. Moreover sunlight assists in the healing of wounds which are on the surfaces of the body and also improves the bactericidal properties of the skin in and about the wound. In this respect it is essential that direct sunlight be had without the intervention of any media which absorb the important rays.

Emerson, who is Professor of Public Health Practice, Columbia University, is of the opinion that today in northern climates the most important problem of environment in the city is provision for sufficient light, direct or diffuse from sun or sky, to maintain sanitation of rooms and halls. He states that through the disinfectant property of light—which is not to be hindered by

curtains and dirty glass—much will be accomplished to reduce the viability and virulence of common human pathogens.

Acute Anterior Poliomyelitis: A Pediatric Problem. F. R. Janney. Wisconsin M. J. **32**: 7, 1933.

The author emphasizes an important point when he states that the clinical picture of infectious diseases varies with epidemics and also with localities. In this respect acute anterior poliomyelitis is no exception, and Janney reports some of his observations on a group of children coming down with anterior poliomyelitis during an epidemic last summer in Milwaukee.

In his series of 26 cases this clinician noted that stiffness of the neck was the outstanding physical sign. Attempts to bend the head forward invariably caused resistance and pain. Flexion of the spinal column also produced pain. Fever was present in almost every instance. Vomiting, anorexia and drowsiness were noted fairly frequently during the first stages of poliomyelitis. Headache was a rather common symptom in older children, and pain in the extremities particularly on handling was noted in about half the cases.

Janney rightly states that many cases of anterior poliomyelitis go unrecognized. This is particularly true during epidemics. The importance of this fact is to be noted in adults who thus acquire immunity to this disease, and because adults usually have specific antibodies against poliomyelitis the author suggests that the blood of parents be given as a prophylaxis to children whenever there is an epidemic of poliomyelitis.

In regard to the treatment of infantile paralysis Janney quotes such authorities as Flexner, Kramer and also Park who state that the use of convalescent serum is of little or no value in the treatment of anterior poliomyelitis even if it be given in the preparalytic stage.

Familial Retardation in Ossification of the Carpal Centers. Alfred F. Hess and Harold Abramson. J. Pediatrics **3**: 1, 1933.

The authors report their interesting observation covering a period of five years on two brothers who showed prolonged retardation in the development of their carpal centers. This report serves as an illustration of the rôle of congenital and constitutional factors in relation to ossification. Hess and Abramson are in accord with others when they state that there is a similarity between brothers and sisters in regard to the rate and stage of carpal development. This similar constitutional variation has been reported previously by Hess and other authorities in connection with the susceptibility to rickets. From both experimental study and clinical observations it was noted that there may be a definite constitutional tendency to rickets quite apart from diet, hygiene and growth.

This article by Hess and Abramson emphasizes the fact that congenital and constitutional factors play a rôle and must be considered in studies bearing on the physiology and pathology of calcification and ossification. Their investigation seems to strengthen the prevailing opinion that although ossifica-

tion of the skeleton depends on systemic factors it is also dependent on some local calcifying factor which is sometimes called a mordant.

Saliva and Coagulation of Blood. Carroll J. Bellis and F. H. Scott. Proc. Soc. Exper. Biol. & Med. **30**: 9, 1933.

In a previous communication the authors found that saliva markedly decreased the coagulation time of the blood. In this communication these investigators, who write from the Department of Physiology, University of Minnesota, report that the coagulant in saliva is nonspecific, in regard to either its source or its source in the blood. They state that the bleeding in individuals with hemophilia is due to the inability of the blood to clot because there is a delay in the rupture of platelets to yield "tissue extracts" and to a delay in the rate of conversion of prothrombin to thrombin. It is interesting to note that they report that the blood of these individuals can be clotted by the addition of small amounts of saliva, either their own or that of normal individuals.

The International Journal of Orthodontia and Dentistry for Children

PUBLISHED THE FIFTEENTH OF EVERY MONTH BY

THE C. V. MOSBY CO., 3523-25 Pine Blvd., St. Louis, Mo.

Foreign Depots—*Great Britain*—Henry Kimpton, 263 High Holborn, London, W. C.; *Australasia*—Stirling & Co., 317 Collins Street, Modern Chambers, Melbourne; *India*—"Practical Medicine," Egerton Street, Delhi; *Porto Rico*—Pedro C. Timothee, Rafael Cordero 68, San Juan, P. R.

Subscription Rates—Single Copies, 75 cents. To any place in United States, Cuba, Porto Rico, Canal Zone, Mexico, Hawaii and Philippine Islands, $7.00 per year in advance. Under foreign postage, $7.40. Volume begins with January and ends with December of each year.

Remittances—Remittances for subscriptions should be made by check, draft, post office or express money order, payable to the publishers, The C. V. Mosby Company.

Contributions—The editor will be pleased to consider the publication of original communications of merit on orthodontic and allied subjects, which must be contributed solely to this Journal.

Opinions—Neither the editor nor the publisher holds himself responsible for the opinions of contributors, nor are they responsible for other than editorial statements.

Reprints—The publishers will communicate with authors regarding reprints upon publication of paper.

Communications—Contributed articles, illustrations, letters, books for review, and all other matter pertaining to the editorial department should be addressed to the Editor, Dr. H. C. Pollock, 4482 Washington Blvd., St. Louis, Mo. All communications in regard to advertising, subscriptions, change of address, etc., should be addressed to the publishers, The C. V. Mosby Company, 3523-25 Pine Blvd., St. Louis, Mo.

Illustrations—Such half-tones and zinc etchings as in the judgment of the editor are necessary to illustrate articles will be furnished when photographs or drawings are supplied by the authors of said articles.

Advertisements — Objectionable advertisements will not be accepted for publication in this Journal. Forms close first of month preceding date of issue. Advertising rates and sizes on application.

Change of Address—The publishers should be advised of change of subscriber's address about fifteen days before date of issue with both new and old addresses given.

Nonreceipt of Copies—Complaints for nonreceipt of copies or requests for extra numbers must be received on or before the fifteenth of the month of publication; otherwise the supply may be exhausted.

Entered at the Post Office at St. Louis, Mo., as Second-Class Matter

EDITORIALS

Who Are Specialists?

ALONG with other questions during these times, there is still the much mooted question of "Who and When Is a Specialist a Specialist?" The congress on medical education has recently had a symposium on this subject, and the resultant discussion has exposed a number of interesting things in regard to this question; for instance, there seemed to be no controversy as to the importance of specialists being required to "qualify" as specialists. The question plainly is by what method and formality shall the specialist qualify as a specialist, and how shall the layman, in turn, know that the specialist is qualified and capable of performing a superior service?

The secretary of the Federation of State Medical Boards contended that the question of the qualifications of specialists is not one for State Board of Examiners, because who is to say when and how the State Board personnel is qualified to pass on the professional attainments of highly specialized men and women. The State Board it was contended, however, should maintain a registry of specialists, that would be always available, but the qualifications of specialists, it was pointed out, are always best known within their own ranks.

The above opinions parallel perfectly the action of the American Society of Orthodontists when it took the first step at Estes Park, under the presidency of Dr. Ketcham, in appointing the American Board of Orthodontia, which was created for the purpose of qualifying orthodontists within the ranks of the specialty itself by other practitioners who know what these qualifications should be.

In the symposium already mentioned, a representative of the medical schools expressed the opinion that the qualifications of specialists is not a matter for medical schools or universities to pass upon, and the National Board of Examiners took the position that while it is not their function or within their premise to pass upon the ability and qualifications of specialists, they were very glad, however, to cooperate to the fullest extent in order to unify the work of the various specialty qualifying boards, which have been set up within the specialties themselves.

Certain fundamental things then seem to be accepted almost unanimously in regard to the qualifying of specialists by those who have given the matter sufficient attention to be well versed on the subject. These basic facts are:

1. Qualification of specialists has become both urgent and necessary in the United States.

2. Qualification must be based on standards of special knowledge, skill and training in some particular field.

3. Those working in a special field are best fitted to determine the knowledge required and to pass upon the qualifications of an individual who desires to specialize in a particular field.

4. There should be no "tape measure" used in appraisement other than that of sheer merit in his line, added to which are the integrity and character of the individual.

5. Any plan of qualifying must be national rather than local and must be entirely just and fair.

6. There must be cooperation between the specialty qualifying boards, the national societies, the various state boards and the National Board of Examiners.

The organizing and perfecting of the American Board of Orthodontia by the American Society of Orthodontists obviously is in complete accord with the present consensus of opinion among various medical groups that each specialty should organize a qualifying board, national in scope, with the sole function of qualifying practitioners. That the state boards of health by a "State Registry of Specialists," and the professions through their pub-

lications, should give publicity to those who have qualified as specialists. Information in regard to qualified specialists should be available not only to the professions themselves, but to the laity, and it should be known that such information is available in each state.

The development of special departments in the practice of dentistry has been an important phase in the trend of practice as a whole. The presumption of the supposed better economic conditions incident to the practice of a specialty has been, no doubt, responsible to some extent for the rapid increase in members added to the field of specialists, in the past.

It is important, however, under present conditions that professions and the public be protected to the extent that they may be able to be assured when a specialist announces himself as such, that he is equipped with a knowledge of his particular subject of sufficient breadth and scope that he is able to perform superior service.

The practice of orthodontia has now arrived at the stage, it is quite generally agreed, where its workers should give much thought, time and effort to the nurturing of its caste and efficiency. There can be no question that incompetency and exploitation have crept within its ranks. Cases of distoclusion have been treated with no attempt being made whatever to shift the occlusion. Promiscuous extraction of teeth for the correction of malocclusion has again appeared after having been buried for twenty-five years.

There is grave need for the American Board of Orthodontia in order to maintain the standards set by conscientious workers in the development and growth of the field of orthodontia. The specialty is not unlike many other things during these days which have been self-satisfied; it is plainly suffering from "growing pains" which may be a result of the "tail wind" which follows all movements which are forward.

—*H. C. P.*

Resolution of the Nebraska State Dental Society

The following resolution was unanimously passed by the Nebraska State Dental Society during the last annual meeting, May 15-18, 1933:

WHEREAS a commission representing the Association of American Medical Colleges, and known as the Commission on Medical Education, which has been conducting a study of medical education, has published in book form a "Final Report of the Commission on Medical Education," and

WHEREAS on pages 216, 217 of said final report the Commission records its opinion that "Dentistry should be developed *under* medical education," and

WHEREAS no evidence is available of any effort on the part of the Commission to discuss this subject with an existing similar commission, known as "The Committee on Survey of the Dental Curriculum," with the American Association of Dental Schools, or with any authoritative body interested in and familiar with dental education or "dentistry," and

WHEREAS, the Carnegie Foundation Survey of Dental Education by Dr. Wm. Gies of New York City recommended that the practice of dentistry be maintained as a separate entity

WHEREAS, the past and present relationship between the medical and dental educational bodies has been so cordial,

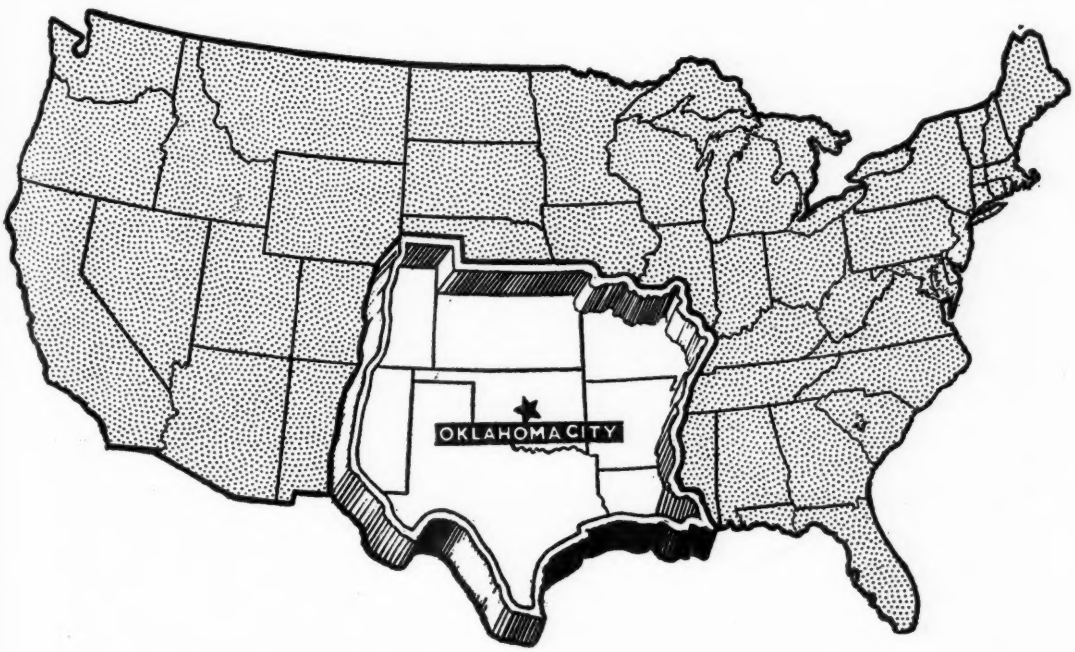
Resolved That the Nebraska State Dental Society in annual session convened does hereby by affirmative vote disapprove of the actions and suggestions of the Commission on Medical Education, for the subjugation of the dental profession.

(Signed) F. A. PIERSON, *Secretary,*
Lincoln, Neb.

NEWS AND NOTES

American Society of Orthodontists Annual Meeting in Oklahoma City November 8, 9, and 10

The Thirty-Second Annual Meeting of the American Society of Orthodontists will be held November 8, 9, 10, 1933, in the Biltmore Hotel, Oklahoma City, Oklahoma.



The geographical location of Oklahoma City, near the central section of the United States, will make it reasonably easy to reach from all sections of the country over the highways, railways, and airways, or any way you choose to come.

The American Society of Orthodontists and Oklahoma City are calling you to attend.

Attend the American Society of Orthodontists' Convention in Oklahoma City

It is now time we were doing some serious thinking in the way of planning to attend the 1933 meeting of the American Society of Orthodontists. These dates should be crossed off the orthodontist's calendar without any delay and every effort bent toward making this meeting an outstanding success. The fellowship to be enjoyed at these meetings in itself fully justifies every man's attendance. There is no better way to

enjoy the meeting in full measure than to organize an excursion party to go by automobile, airplane, or train. Those living within driving range should find it an easy matter to organize an automobile party in their communities. By pooling the traveling expense, it will make an inexpensive trip. The added pleasures of such a trip will make it one long to be remembered.

We must attend our orthodontia meetings if we are to receive any great amount of good from the organization. It has been wisely said that we get little if any more good from an organization than we put into it. If we fail to attend, there is comparatively little chance of putting anything in or getting anything out of it. A membership card in an organization without regular meetings would not be worth the annual dues. It is at the meetings that real progress in orthodontia is made. Every member is given the opportunity of hearing valuable papers with discussions by men with different ideas and of hearing reports of interesting and unusual cases. Here we may study the clinics and exhibits and gain much in practical as well as theoretical knowledge. Best of all, each member may participate actively in all of the Society's functions. Then, too, there are always matters relating to the business side of practice. Special business affairs of orthodontia in its public relations through legislation and orthodontia education must be considered and acted upon. These items are naturally our obligation, and we should give them our earnest thought and attention.

It is a genuine inspiration for the newer men in orthodontia to meet the prominent men and leaders in orthodontia and to note their earnest and generous participation in the various activities of the organization. These meetings offer an opportunity to better understand our problems by mingling and exchanging ideas with our fellow members. We shall find inspiration and renewed courage, which we need more than anything else.

We shall miss the several notable men who recently passed away, but the work of these splendid characters will live for many years to come. The spirit of these men will still carry on if we rise to the occasion as we always have done by giving orthodontia the man power it must have if proper progress is to be made. There is more than enough work to go round, so let each and every man resolve to do his part in boosting orthodontia and the meeting.

A splendid program has been arranged, let's all go and hear the papers, see the clinics and last but not least, meet again the men who make up the American Society of Orthodontia!

Charles R. Baker.

American Society of Orthodontists to Meet in Popular Convention City

Oklahoma City by virtue of its central location in the state and nation, with its large number of fine hotels and hospitable spirit, is attracting an ever increasing number of important conventions. While Oklahoma City is generally recognized as being in the southwest, it is little more than 200 miles south of the center of the United States and easy to reach by railways, air lines and numerous highways.

During 1933, Oklahoma City will have entertained a larger majority of the important state conventions of business and professional groups than in any year of the city's history. There are only a very few of this class of conventions that have not been held or are not definitely scheduled to meet in Oklahoma City this year.

The conventions' committee of the Chamber of Commerce is continuing its cooperation with the Oklahoma City Clinical Society in sponsoring each year its annual Clinical Conference, which is rapidly becoming the outstanding medical meeting in the southwest. Its attendance has been increased each year since its establishment four years ago in spite of the fact that the attendance record at other important medical meetings over the country shows that practically every one of them has decreased in attendance.

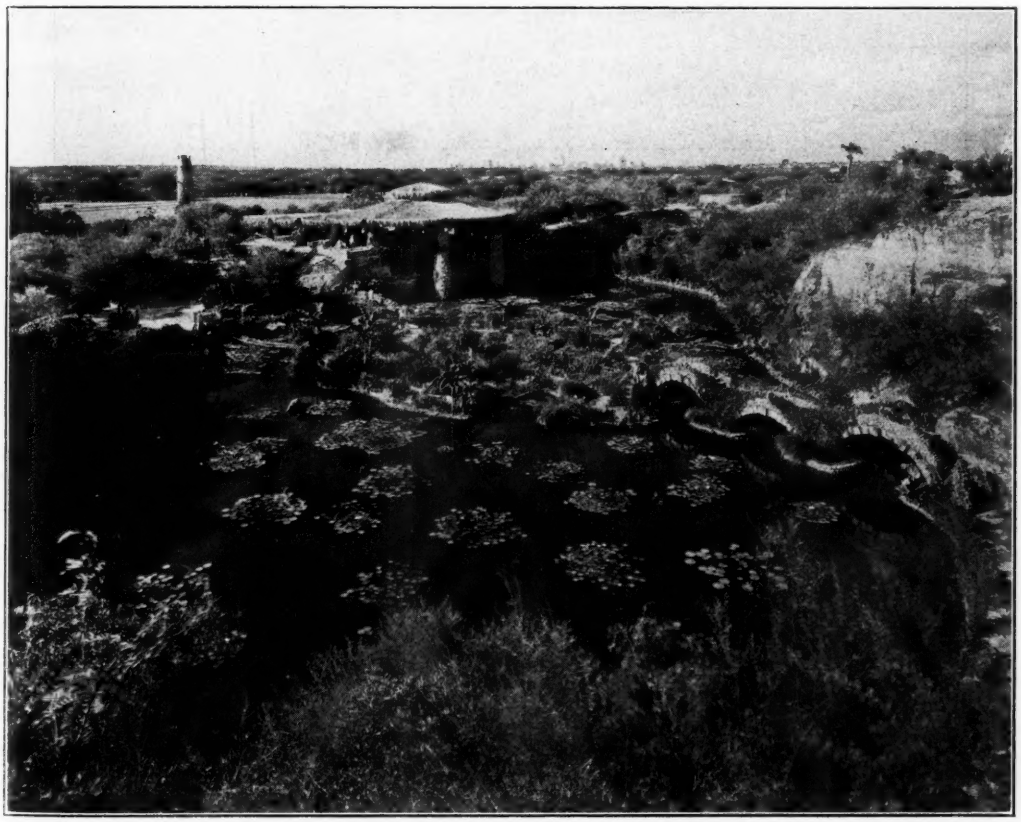
This conference attracts an attendance from all of the states of the southwest and in addition to bringing large numbers of physicians and surgeons here during the conference, it has resulted in large numbers of patients being sent in throughout the year for consultation and treatment by Oklahoma City doctors.

The conventions' committee of the Oklahoma City Chamber of Commerce is putting forth its best efforts in assisting the local arrangements committee for the American Society of Orthodontists to make the convention the most enjoyable they have ever held.

San Antonio, Corpus Christi, Aransas Pass, Texas and Monterrey, Old Mexico

EXCELLENT SIDE TRIPS AND STOP-OVER POINTS TO AND FROM THE ANNUAL MEETING OF THE AMERICAN SOCIETY OF ORTHODONTISTS

San Antonio is a picturesque city of contrasts, set in a fertile valley 700 feet above sea level—a modern city two hundred years young, where the best traditions of colonial Spain, the



A scene of the Japanese Sunken Garden and Polo Field in the background in Breckenridge Park.

old South and the robust Southwest happily blend, where a quarter million people take time to live, "mother city" of the far-flung empire of south and west Texas, gateway to Mexico, now, as it has been for centuries, a spot so lovely that Spain and France warred for its possession two hundred years ago. Haunted by the memory of its stirring past, San Antonio wears a mantle of romance woven by the marching centuries, her very streets immortalizing heroic names and deeds.

Every American should see San Antonio—whether your stay is limited to one day or can be prolonged to three months in this glorious climate.

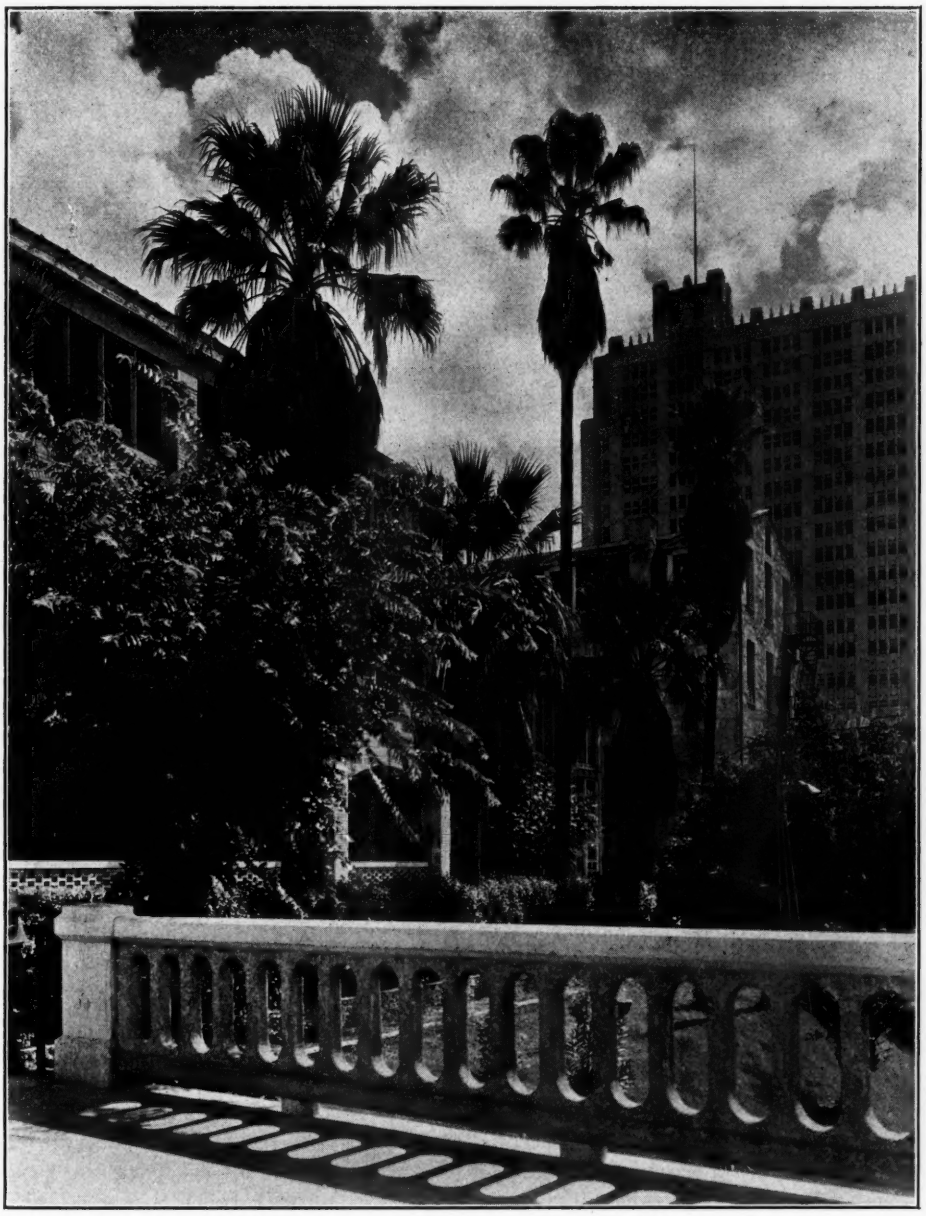
For those of you who have time to spend a few days in San Antonio either going or coming from the convention in Oklahoma City, there are many delightful and interesting things the boys in San Antonio would like to show you. Side trips to Corpus Christi and to Port Aransas,

The Alamo and Alamo Plaza in the heart of San Antonio, with the Medical Arts Building looking down on historic ground, which was the scene of the battle of the Alamo, the Thermopylae of Texas.

which are probably the greatest tarpon fishing points on the gulf; and Monterrey, Old Mexico, is an interesting place to visit.

The visitor will begin, naturally, with a pilgrimage to the Alamo, that shrine of liberty hallowed by the blood of martyrs. The Alamo, in Alamo Plaza, is in the heart of the business district. Erected as a church and fortress by the Franciscan padres, the walled Alamo served as house of worship, school for Indian converts, and haven for early settlers beset by savages.

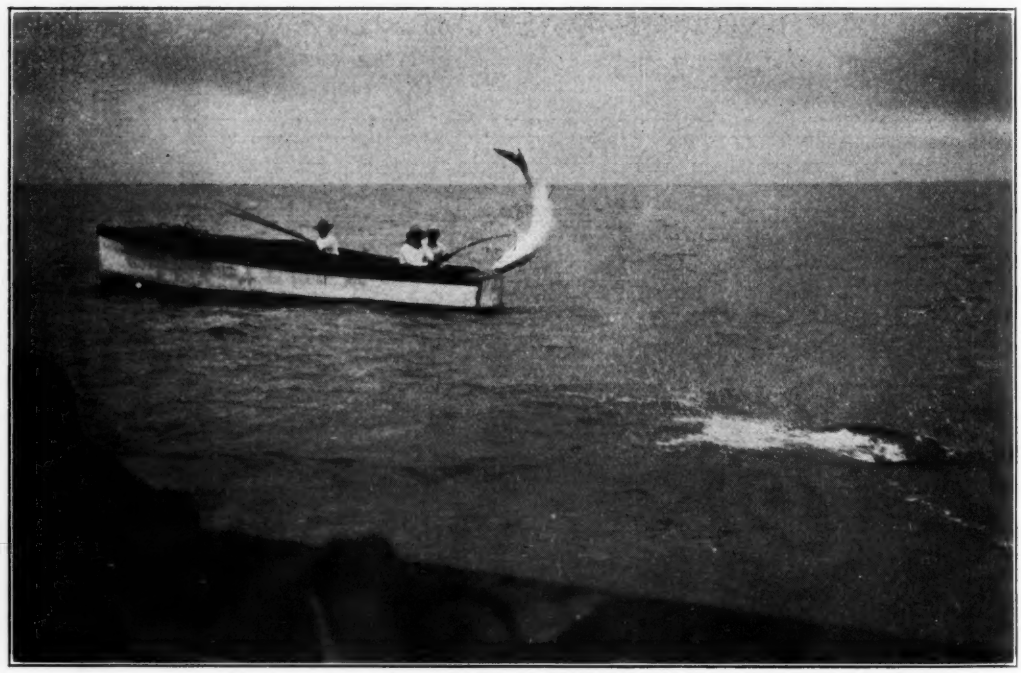
When Texas declared her independence from Mexico, the Alamo again became a fortress, and on March 6, 1836, after a seige of two weeks, it fell before the onslaught of the Mexican army under Santa Anna. Not a man of its garrison of 182 lived to tell of defeat. The battle cry of "Remember the Alamo" carried the Texans to victory at San Jacinto, on April 21 of the same year—and the Republic of Texas was born. East on Commerce at the corner of Rusk, tablets may be seen on both north and south sides of the street marking the sites of the funeral pyres of the Alamo heroes.



The Nix-Professional Building.

San Fernando in Main Plaza is the Cathedral which takes its name from Ferdinand of Spain, who made it a royal chapel in 1744 by grant of money to help complete and enlarge the structure. According to tradition, its altar shelters the ashes of the Alamo defenders. The iron cross atop the dome of San Fernando is still, after two centuries, the geographical center of San Antonio.

Strung along the South Loop (a paved road fourteen miles long) are the missions. To reach the South Loop by automobile from downtown, go south on South Saint Mary's Street and Roosevelt Avenue to Mitchell Street and turn right on Mitchell. Mission Conception, originally founded in East Texas, was removed to San Antonio in 1731. Built by Franciscan padres, with the aid of Indian labor, its chapel is still in use. Mission San Jose, a great pile of gray stone, is famous for its south window, acclaimed as one of the finest examples of stone carving in America. A chapel has been restored, and services are again held in San Jose. San Juan, last on the loop, is little more than a crumbling facade of the old mission, except for its recently restored chapel. But San Francisco de la Espada, off the loop a mile, and one of the oldest missions in Texas, is still in use, with a little mission school conducted by nuns who live in the restored barracks which form a part of the old walled enclosure. A tablet adjacent to Mission Conception marks the site of a battle between Mexicans and Texans several months preceding the fall of the Alamo.



A tarpon in action.

Facing San Fernando Cathedral from the west side of Military Plaza is the Old Spanish Governor's Palace, only recently restored, a fascinating reminder of the days when viceroys ruled San Antonio in the name of the King of Spain.

To the visitors from inland America, San Antonio is like a trip abroad, for south and west of the Old Spanish Governor's Palace is a bit of Old Mexico! Here vendors of pottery, basket work and Mexican foods display their wares in tiny sidewalk bazaars. And Haymarket Plaza (just west of Milam Square), a busy fruit and vegetable mart by day, becomes by night the center of outdoor life in the quarter. Torches flare over the chili stands which flank the plaza's boundaries, and snatches of song accentuate the melody of Spanish, the only language heard.

It is a trip of only a few hours from San Antonio to Mexico! Visitors wishing the thrill of entering that remarkably interesting foreign country have their choice of going via Laredo, Eagle Pass, Brownsville or Del Rio—all border cities within convenient distance. Paved roads facilitate motor travel, and railroads and bus lines are also in operation.

San Antonians have dedicated over 2000 acres to public play, and more than threescore parks and plazas dot the city, varying in size from a tiny triangle or circle of greensward to the 1200 acres of Olmos Park, still largely in the natural state. Nineteen fully equipped playgrounds for children serve every section of the city.

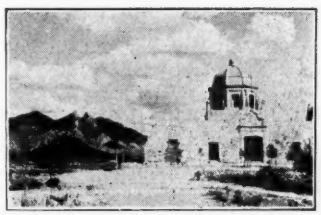
Most famous of San Antonio's parks is Brackenridge with its noted Japanese Sunken Garden; its Sunken Garden Theatre, a great natural bowl where civic opera performances are staged during the summer months; Witte Museum, housing the San Antonio Art League's paintings and a fascinating exhibit of bygone days in Texas, including a collection of branding irons. In Brackenridge Park, too, are bridle paths, swimming pool, tennis courts, municipal golf links, polo field, baseball diamond, Lion's Field playgrounds, Boy Scout headquarters, and picnic spots galore, with grills available for outdoor cooking. San Antonio's Zoological Gardens are also in Brackenridge Park. There are more than 1,000 fine specimens, including rare water fowls, birds, fauna native to Texas, barless bear pits, the famous "Primate Paradise" where monkeys, lions and other cats, deer and many other animals disport.

To the southeast of San Antonio some three hours ride by automobile is Corpus Christi, situated on the gulf overlooking Corpus Christi Bay, and the gateway to the Rio Grande Valley.

Some twenty miles north of Corpus Christi and on the mainland six miles across Red Fish Bay from Port Aransas lies the picturesque town of Aransas Pass. Its chief claim to distinction is that it is a most delightful place to live. Situated on the 28th parallel of north latitude, its winters are mild tempered while its summers are made pleasant by a never failing Gulf breeze.

Port Aransas is situated on Mustang Island, where the gulf and bay meet, and marks the entrance to the channel that leads into Corpus Christi.

A scene of three palms on the bay front near the Nueces Hotel at Corpus Christi.



The Obispado, with the famous saddle mountains in the background, Monterrey.

The name "Aransas" is of Indian derivation. Translated it means "haven of rest." In 1864 one of the first lighthouses to dot the Texas coast was built to mark the spot as a terminal of the roads of the sea. Its beacon guided the ships of many nations to safe harbor; ships that brought goods of all descriptions to that section.

But ocean vessels are not the only moving things to cruise the water of Port Aransas. The area abounds with a wide variety of fish, the quantity of which is unsurpassed by any Gulf coast section. Certainly it is a paradise for those followers of Izaak Walton's art who angle for the fighting tarpon.

Monterrey, Old Mexico, is a city of 200,000 people, one hundred and fifty miles from the border; and it is well worth any one's time to visit this interesting and historic city.

Organize a party and come this way, explore south and west Texas. The latchstring is out—San Antonio bids you welcome to Texas!

If you are interested in joining a fishing party to the Gulf just before or after the convention, or if you desire further information write to Dr. T. G. Duckworth, Medical Arts Bldg., San Antonio, Texas.

The American Board of Orthodontia

The fourth annual meeting of the American Board of Orthodontia will be held in Oklahoma City at the Biltmore Hotel on November 6 and 7, 1933.

Those orthodontists who desire to qualify for a certificate from the Board should secure the necessary application form from the secretary. Applications received up to the date of the meeting in Oklahoma City will receive preliminary consideration by the Board and

the required examination will be outlined. It will not be necessary for new applicants to appear before the Board at this time. However, such applicants should appear before the Board at the next annual meeting.

Attention is called to the following resolutions adopted by the Board:

Any person desiring to make application to the Board for a certificate shall have been in the exclusive practice of orthodontia for a period of not less than five years or an equivalent to be determined by the Board and based upon the following conditions:

First, an instructor in orthodontia in a school satisfactory to the Board.

Second, an associate in the office of an orthodontist whose standing is satisfactory to the Board.

It is, however, definitely to be understood that any person at the time of making application for a certificate shall be in the exclusive practice of orthodonia in his own name.

ALBERT H. KETCHAM, President,
Republic Building,
Denver, Colo.

OREN A. OLIVER, Secretary.
Medical Arts Building,
Nashville, Tenn.

Greater New York December Meeting

The ninth annual Greater New York December Meeting will be held at the Hotel Pennsylvania, New York City, Dec. 4-8, 1933.

This meeting is held under the auspices of the First and Second District Dental Societies of the State of New York.

CARROLL B. WHITCOMB, Chairman.

Reorganization of Dental Staff of Bronx Hospital

The reorganization of the dental staff of the Bronx Hospital permits a number of appointments to be made in the various departments of dentistry.

Applications may be made to the Bronx Hospital, Fulton Avenue at 169th Street, Bronx, N. Y.

DAVID WURZEL, Chief of Clinic.